DOE/RL-2004-46
Rev. 0

Engineering Evaluation/ Cost Analysis for the 105-N Reactor Facility and 109-N Heat Exchanger Building

United States
Department of Energy

For External Review

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United States Department of Energy

P.O. Box 550, Richland, Washington 99352

EXECUTIVE SUMMARY

This document presents the results of an evaluation of three removal action alternatives for interim storage of the 105-N Reactor Building and disposition of the 109-N Heat Exchanger Building. A final disposition decision for the 105-N Reactor has not been made and will be subject to later evaluation and implementation. Interim safe storage is being implemented on the other Hanford Site production reactors (58 *Federal Register* 48509). The 75-year safe storage period is adequate to allow for radionuclide decay that contributes significantly to minimizing occupational dose. In preparing a facility for interim safe storage, the building footprint is reduced to minimize the amount of contaminated material, building components and structures are sealed to eliminate intrusion, and a new roof is constructed over the remaining portions of the facility to ensure structural integrity and protect human health and the environment. After interim safe storage is completed, surveillance and maintenance is conducted to ensure the integrity of the interim safe storage structure and containment of hazardous substances.

This evaluation is different from the other Hanford Site reactor interim safe storage engineering evaluations that were done for the 105-C, 105-D, 105-DR, 105-F, and 105-H Reactors because the 105-N Reactor is not a stand-alone facility. The 105-N Reactor served a dual mission by producing special nuclear materials and providing steam to generate electricity. The 105-N Reactor shares a common wall with the 109-N Heat Exchanger Building and contains the piping gallery that provided the piping systems that interconnected the reactor core with the steam generator cells. The piping gallery in the 109-N Heat Exchanger Building was the conduit for transferring the pressurized, closed-loop, primary coolant from the reactor core to the steam generator cells; the heat exchangers within these cells then transferred the heat to the secondary loop that provided steam to the Hanford Generating Plant for powering the steam turbines to produce electricity. Disposition of the 109-N facility is considered in the evaluation of interim safe storage of the 105-N Reactor due to concerns over the structural integrity of separating the two facilities and because of contact with the primary coolant within the piping systems and steam generator cells in the 109-N Heat Exchanger Building. Allowing the radionuclides to decay before final disposition of the 109-N Building reduces exposure to workers and the environment from these systems, similar to what will be encountered in disposition of the reactor core.

Removal actions evaluated for the 105-N Reactor and 109-N Heat Exchanger Building are no action, interim safe storage, and long-term surveillance and maintenance. The evaluation approach follows that which has been implemented at the Hanford Site 105-C, 105-D, 105-DR, 105-F, and 105-H Reactor facilities. The alternatives are summarized below.

- The no action alternative assumes all short-term and long-term maintenance of the facility is terminated and the facilities are locked to prevent entry.

- Interim safe storage, which has been performed or is in progress at other Hanford Site reactor facilities, includes decontamination and demolition of the reactor facility up to the shield walls that surround the reactor block, the construction of a safe storage enclosure, and surveillance and maintenance. Interim safe storage of the 109-N Heat Exchanger Building includes decontamination and demolition of the external sections of the building up to the shield walls around the steam generator cells, construction of a safe storage enclosure, surveillance and maintenance of the enclosure, and final decontamination and demolition of the steam generator cells and piping gallery concurrent with the final disposition of the 105-N Reactor.

- The long-term surveillance and maintenance alternative includes an extended period of facility monitoring, followed by full decontamination and demolition of the 109-N Heat Exchanger Building and partial decontamination and demolition of 105-N in preparation of final disposition of the 105-N Reactor block.

Present-worth cost estimates for the three alternatives are shown in Table ES-1. Consistent with guidance established by the U.S. Environmental Protection Agency and the U.S. Office of Management and Budget, present-worth analysis is used as the basis for comparing costs of cleanup alternatives under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* program (EPA 1993).

Table ES-1. Cost Comparison for Final Configuration Alternatives for the 105-N Reactor and 109-N Heat Exchanger Building.

Alternative	Present-Worth Cost
Alternative 1 – No Action	No cost
Alternative 2 – Interim Safe Storage	$77,096,000
Alternative 3 – Long-Term Surveillance and Maintenance	$101,766,000

The recommended removal action alternative for the 105-N Reactor facility and the 109-N Heat Exchanger Building is interim safe storage followed by decontamination and demolition of the 109-N steam generator cells at a future date not yet determined. This alternative is consistent with the previous evaluations for the 105-C, 105-D, 105-DR, 105-F, and 105-H Reactors. This alternative is recommended based on its overall ability to protect human health and the environment and its effectiveness in maintaining protection for both the short term and the long term. The alternative would also reduce the potential for a release to the environment by reducing the inventory of contaminants. This alternative provides the best balance of protecting human health and the environment, protecting workers, achieving cost effectiveness, and providing an end state that is consistent with future cleanup actions and commitments of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1998).

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FR	*Federal Register*
HGP	Hanford Generating Plant
ISS	interim safe storage
NEPA	*National Environmental Policy Act of 1969*
NHPA	*National Historic Preservation Act of 1966*
OU	operable unit
PCB	polychlorinated biphenyl
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	DOE, Richland Operations Office
ROD	record of decision
S&M	surveillance and maintenance
SSE	safe storage enclosure
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the results of an engineering evaluation/cost analysis (EE/CA) that was conducted to evaluate interim storage options and recommend an interim storage approach for the 105-N Reactor complex. The N Reactor complex consists of the 105-N Reactor Building (N Reactor or 105-N), the 109-N Heat Exchanger Building, and adjacent buildings and is located in the 100-N Area of the Hanford Site. The U.S. Department of Energy (DOE), Richland Operations Office (RL) has determined that there is no further use for the N Reactor (DOE-RL 1994a). A final disposition decision for the N Reactor has not been made and will be subject to later evaluation and implementation. However, hazardous substances[a] in the N Reactor complex present a potential threat to human health and the environment to the extent that a removal action[b] is warranted before final disposition. An action memorandum, which will be developed from this EE/CA, will document and authorize implementation of the removal action that is selected for the N Reactor complex.

The facilities within the scope of this evaluation are the 105-N Reactor Building and the 109-N Heat Exchanger Building (109-N). Effluent pipelines leading from the N Reactor complex to waste disposal facilities have been addressed in a separate decision document (EPA 2000a). In addition, contaminated soils associated with the N Reactor complex are generally excluded from this evaluation and are deferred to the remedial action program for the 100-NR-1 Operable Unit (OU).

1.2 BACKGROUND

The Hanford Site is a 1,517-km^2 (586-mi^2) federal facility located in southeastern Washington State along the Columbia River (Figure 1-1) and operated by RL. From 1943 to 1990, the primary mission of the Hanford Site was production of nuclear materials for national defense. The 100 Area is the site of nine now-retired nuclear reactors and associated support facilities that were constructed and operated to produce weapons-grade plutonium. Past operations, disposal practices, spills, and unplanned releases resulted in contamination of the facility structures, underlying soil, and underlying groundwater in the 100 Area. Consequently, in November 1989, the 100 Area was one of four areas of the Hanford Site that was placed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List under the *Comprehensive Environmental*

[a] "Hazardous substances" means those substances defined by the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), Section 101(14), and include both radioactive and chemical substances.
[b] "Remove" or "removal" as defined by CERCLA, Section 101(23), refers to the cleanup or removal of released hazardous substances from the environment; actions if a threat of release of hazardous substances occur; actions to monitor, assess, and evaluate the release (or threat of release) of hazardous substances; the disposal of removed material; or other actions that may be necessary to prevent, minimize, or mitigate damage to public health or welfare or to the environment, which may otherwise result from a release or threat of release. If a planning period of at least 6 months exists before onsite actions must be initiated, the removal action is considered non-time-critical and an EE/CA is conducted.

Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the *Superfund Amendments and Reauthorization Act of 1986.*

The 100-N Area is that portion of the 100 Area containing the N Reactor and supporting facilities (Figure 1-2). The N Reactor operated from 1963 until 1987, at which time it was placed in standby mode. In 1990, the DOE made the decision that the reactor would not be restarted, and the N Reactor and ancillary facilities were deactivated. Deactivation was completed in 1998. The reactor has been in a surveillance and maintenance (S&M) mode since that time. A final disposition decision for the N Reactor has not been made. It is likely that the decision will be consistent with the approach taken for the other eight reactors in the 100 Area. Disposition alternatives for those reactors were evaluated under the *National Environmental Policy Act of 1969* (NEPA) in the draft and final *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland Washington* (DOE 1989, 1992). The selected disposition approach for the eight reactors as recorded in the record of decision (ROD) was interim safe storage (ISS) followed by deferred one-piece removal (58 *Federal Register* [FR] 48509). The final evaluation report for the disposition of the surplus reactors will be completed in 2005, per the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-93-25, "Submit an Engineering Evaluation of the Final Surplus Reactor Disposition to EPA and Ecology" (Ecology et al. 1998).

The 100-N Area is subdivided into two OUs to address cleanup of the soil and groundwater contamination that resulted from past operations. The 100-NR-1 OU encompasses liquid waste disposal sites, burial grounds, and soil waste sites. It includes four sites that are treatment, storage, and disposal (TSD) units managed under the *Resource Conservation and Recovery Act of 1976* (RCRA). The 100-NR-2 OU addresses groundwater contamination underlying the 100-N Area. The area also includes dozens of ancillary facilities in addition to those addressed in this EE/CA. The scope and role of other cleanup actions in the 100-N Area, and their relationship to this removal action, are summarized in the following subsections.

1.2.1 Waste Site and Soil Cleanup

Approximately 80 waste sites with a range of radioactive and nonradioactive contaminants have been identified in the 100-N Area as part of the 100-NR-1 OU. Remediation of these sites is being conducted under the following decision documents:

- The *Interim Remedial Action Record of Decision for the 100-NR-1 Operable Unit* (TSD ROD) (EPA 2000a) addresses contaminated soils, structures, and pipelines associated with the 1301-N Liquid Waste Disposal Facility (1301-N) and the 1325-N Liquid Waste Disposal Facility (1325-N), which are TSD units under RCRA.

- The *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units* (100-NR-1/100-NR-2 ROD) (EPA 2000b) addresses all of the other remaining soil waste sites in the 100-NR-1 OU, as well as the 100-NR-2 groundwater OU.

- The *100-NR-1 Treatment, Storage, and Disposal Units Corrective Measures Study/Closure Plan* (DOE-RL 2002a) includes a closure plan that was subsequently incorporated into the Hanford Site RCRA permit (Ecology 1998). The closure plan and permit modification specify RCRA closure requirements for the 1301-N, 1325-N, 1324-N, and 1324-NA TSD units.

The selected remedy specified in the RODs and permit modification is removal of contaminated soil and debris to meet an assumed residential-use scenario, treatment (as necessary) to meet disposal facility acceptance criteria, and disposal. This remedy is commonly referred to as "remove, treat, dispose."

Remediation of waste sites in the 100-N Area is underway. The Tri-Party Agreement baseline calls for completing remediation of all sites by 2012. The proximity of some waste sites to the N Reactor complex may require specific scheduling and coordination between the waste site and N Reactor programs. In particular, the 1301-N/1325-N closure plan states that remediation of piping that is associated with the 1301-N, 105-N, and 109-N facilities will be deferred until decontamination and decommissioning (D&D) of the N Reactor complex (DOE-RL 2002a). This deferral is due to safety concerns. Remediation of the piping will require excavation up to the foundation walls of these facilities, thus potentially jeopardizing the integrity of the facilities. Also, the pipelines intersect and/or follow active underground power lines and potable water lines that are currently in use.

1.2.2 Groundwater Cleanup

The primary contaminant in the groundwater underlying the 100-N Area (100-NR-2 OU) is strontium-90. Remediation of strontium-90 was initiated under the *Action Memorandum: N Springs Expedited Response Action Cleanup Plan* (Ecology 1994) and has continued under the 100-NR-1/100-NR-2 ROD (EPA 2000b). A pump-and-treat system was constructed in the 100-N Area with the objective of creating a hydraulic barrier, thereby reducing the amount of strontium-90 entering the Columbia River. The treated groundwater is reinjected upgradient in the 100-N Area. The system has operated from 1995 until present (2004).

The effectiveness of the pump-and-treat operations is limited because much of the strontium-90 remaining in the groundwater beneath the 100-N Area is tightly bound to the aquifer sediments, and therefore is not readily extracted for treatment.

1.2.3 Ancillary Facilities Decontamination and Decommissioning

There are approximately 50 ancillary facilities in the 100-N Area within the N Reactor complex. These facilities are being addressed in accordance with the *Action Memorandum for the 100-N Ancillary Facilities* (Ecology et al. 1999). The action memorandum identifies the selected removal action as continued S&M until such time that D&D takes place. D&D of several of the 100-N ancillary facilities has been initiated and will continue. Because of their physical proximity to the 105-N Building, final disposition of four of the ancillary facilities (1722-N Decontamination Building, 1605-NE Observation Post, 105-NA Emergency Diesel

Enclosure, and 105-NE Fission Products Trap) will be coordinated with the selected removal action for the N Reactor complex.

1.3 REMOVAL ACTION AUTHORITY

The *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act* (DOE and EPA 1995) is a joint policy between DOE and the EPA that allows use of the CERCLA removal action process (40 *Code of Federal Regulations* [CFR] 300.415) for deactivation and D&D activities. To qualify for inclusion in the removal action process the facilities must contain hazardous substances. The non-time-critical removal action process also requires preparation of an EE/CA to identify and evaluate alternatives for proposed removal actions.

This EE/CA was prepared in accordance with CERCLA and 40 CFR 300.415 to satisfy environmental review requirements for non-time-critical removal actions, and provide a framework to evaluate and select alternative approaches for a removal action at the N Reactor complex. This EE/CA also specifies actions designed to comply with requirements of the DOE and EPA joint policy (DOE and EPA 1995) and the Tri-Party Agreement. The EPA, Washington State Department of Ecology (Ecology), and RL (referred to as the Tri-Parties) have determined that the facilities included in the scope of this EE/CA qualify for the removal action process based on the known presence of hazardous substances. After the public has had an opportunity to comment on the alternatives and the recommended approach presented in this document, the Tri-Parties will select the most appropriate removal action for the facilities. As the lead regulatory agency, Ecology will prepare an action memorandum (a CERCLA decision document) to reflect the decisions made by the Tri-Parties.

In accordance with a Secretary of Energy policy statement (DOE 1994) and DOE O 451.1B, NEPA values have been incorporated into this EE/CA. The policy statement and DOE order encourage integration of NEPA values into CERCLA documents (such as this EE/CA) to the extent practicable rather than requiring separate documentation. A discussion of NEPA values is included in Section 5.0 of this document.

Figure 1-1. Hanford Site Map.

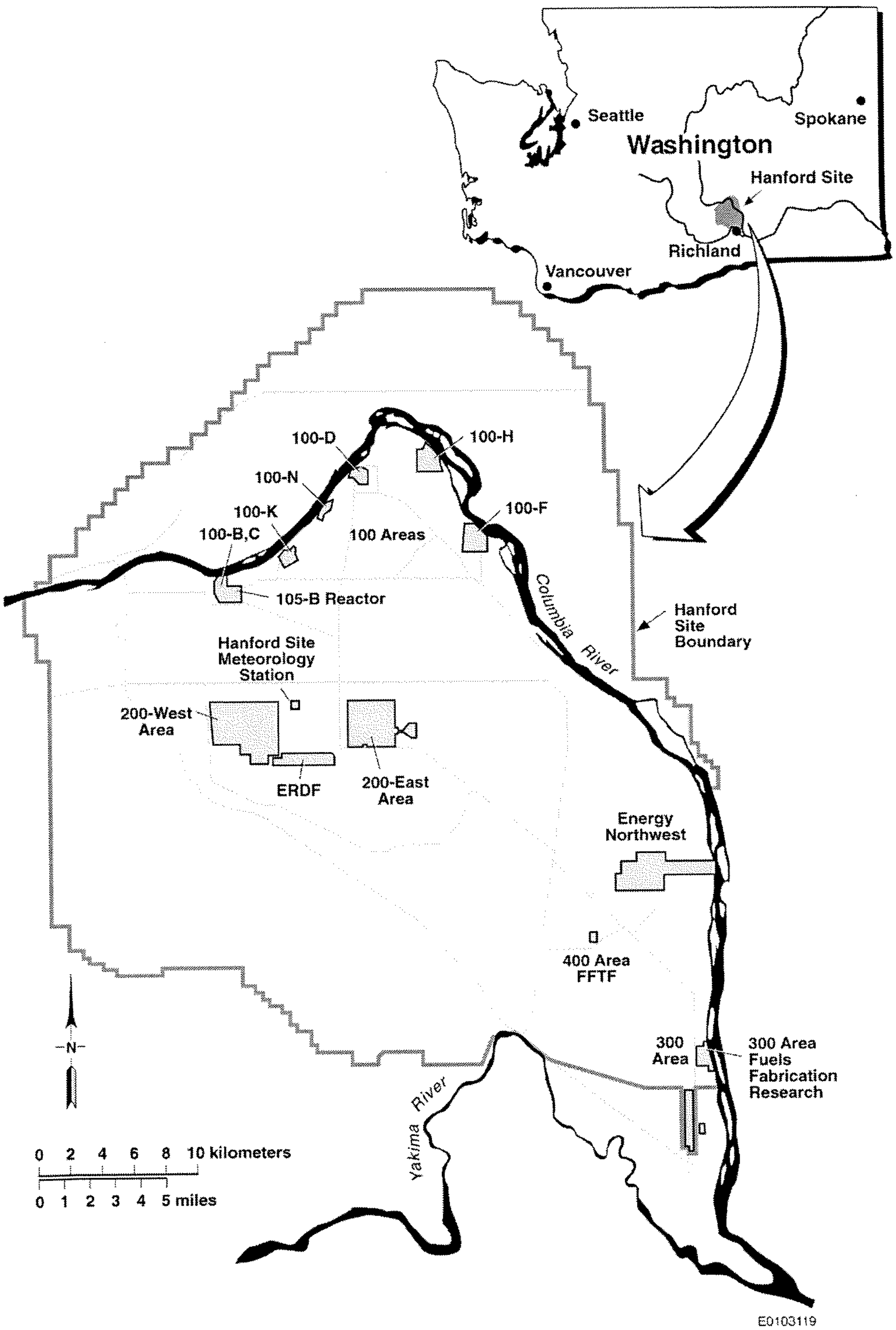
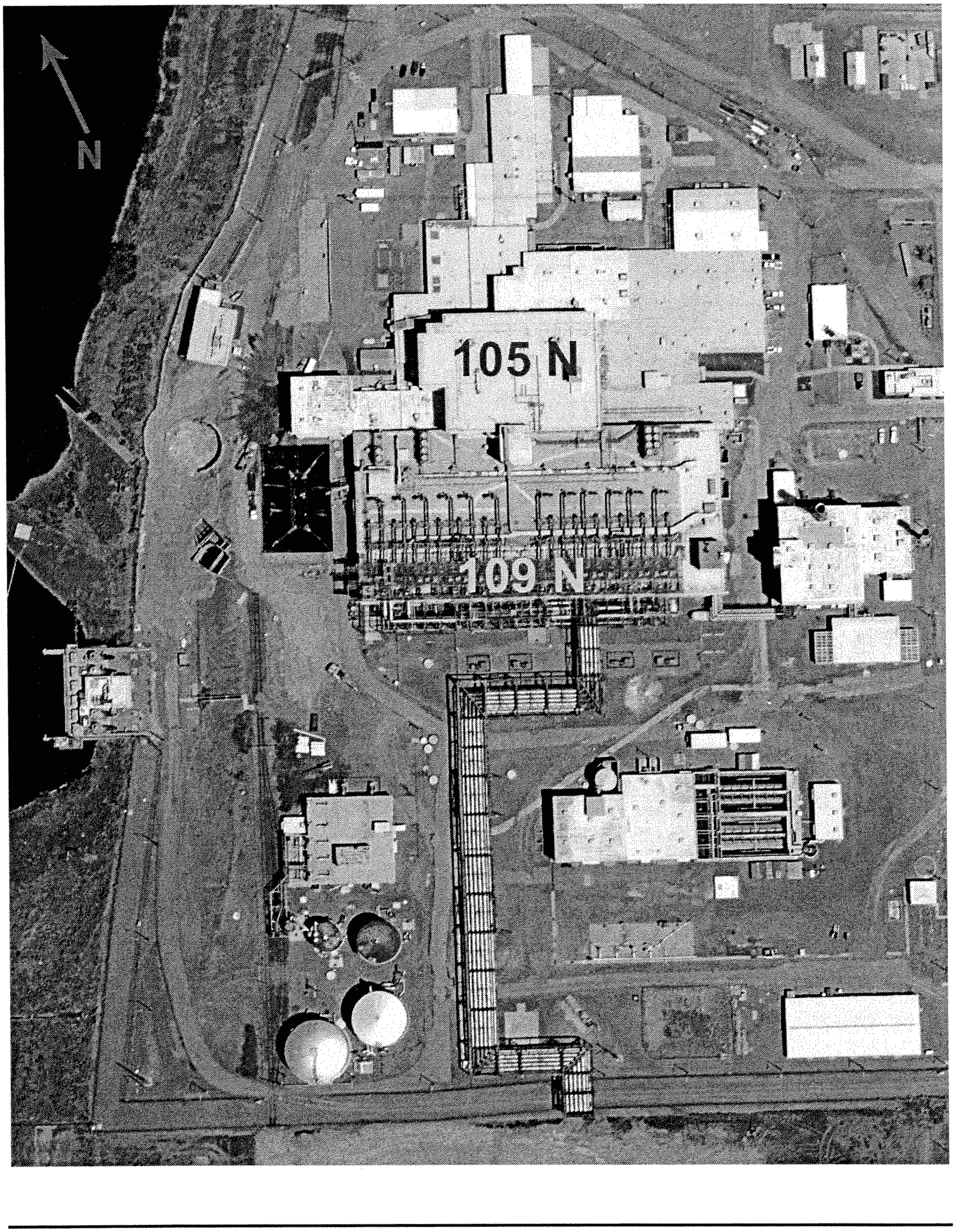


Figure 1-2. Map of the 100-N Area and the N Reactor Complex.



2.0 SITE CHARACTERIZATION

2.1 BACKGROUND AND SITE DESCRIPTION

Background information on the 100-N Area is provided in the following subsections, including operational history, land use and access, ecological setting, and cultural resources.

2.1.1 General Description of the Hanford Site 100-N Area

The 100-N Area of the Hanford Site is located along the southern shore of the Columbia River in southeastern Washington State. The area houses the 105-N Reactor, support facilities such as water treatment facilities, administrative office buildings, laboratories, maintenance shops, and utility structures. The 105-N Reactor served a dual mission, producing special nuclear materials and providing steam to generate electricity. The reactor ceased operations in 1987; preservation efforts were stopped in 1991. Facility deactivation was completed in July 1998, which placed the facilities in a safe and stable condition, minimizing the long-term cost of S&M and protecting workers, the public, and the environment.

2.1.2 Land-Use Access

Public access to the Hanford Site, including the 100-N Area, is currently restricted. Current land use in the 100 Areas consists of DOE spent fuel management activities at the 100-K Area and remediation activities at all of the reactor areas. The Columbia River, which is located adjacent to the 100 Areas, is accessible to the public for recreational use (e.g., boating, sport fishing). The river segment located north of the 100-N Area (referred to as the Hanford Reach) received National Monument status in 2000.

In prehistoric and early historic times, the area along the banks of the Columbia River, including the 100-N Area, was a focal point for camping and village sites for northwest Native American tribes. More recently, before government acquisition of the land in January 1943, the area was used for irrigated and dry-land farming and livestock grazing.

The reasonably anticipated future use of the 100-N Area is preservation/conservation. This land use is consistent with establishment of the Hanford Reach as a National Monument and with the "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)" (64 FR 61615), which provides for four land-use designations in the Columbia River Corridor encompassing the 100 Area. These land uses are (1) preservation, (2) high-intensity recreation, (3) low-intensity recreation, and (4) conservation (mining). The river islands and a quarter-mile buffer zone along the river are designated as preservation to protect cultural and ecological resources. The river islands and a quarter-mile buffer zone also constitute the Hanford Reach National Monument created by Presidential Proclamation 7319 (65 FR 37253), which states that the 100 Areas will not be developed for residential or commercial use, in order to protect the area's cultural and natural resources. The high-intensity and low-intensity recreation designations are limited to specific sites and areas, none of which are in the 100-N Area. The remainder of land within the Columbia River Corridor outside the quarter-mile buffer zone is designated for conservation (mining). This designation will allow the DOE to provide protection to sensitive cultural and biological resource areas, while allowing access to geologic resources in support of governmental missions or to further the biological function of wetlands (e.g., conversion of a gravel pit to a wetland by excavating to groundwater). Restrictions on certain uses may continue to be necessary to prevent the mobilization of contaminants, the most likely example of such restrictions being on activities that discharge water to the soil or excavate below a specified depth.

2.1.3 Flora and Fauna

The ecological setting within the 100-N Area perimeter fence is highly disturbed with large graveled areas adjacent to the facilities. The area surrounding the 100-N Area is characterized as an arid to semi-arid, shrub-steppe vegetation zone. The natural community is a sagebrush/ bitterbrush/Sandberg's bluegrass association. The dominant nonriparion vegetation in the surrounding area includes cheatgrass, Sandberg's bluegrass, rabbitbrush, Russian thistle, and tumblemustard. The animal community in the surrounding area includes species of birds, mammals, reptiles, and insect groups that are adapted to the semi-arid environment. Common mammals that may be found in and adjacent to the 100-N Area include the badger, coyote, Great Basin pocket mouse, northern pocket gopher, blacktail jackrabbit, cottontail rabbit, bushytail woodrat, and porcupine. Common reptiles include rattlesnake, gopher snake, yellow-bellied racer, and side blotch lizards.

Most of the 100-N Area has been characterized as highly disturbed by industrial/waste management operations to the extent that plant communities are sparse and complete ecological communities represented by common food webs cannot be supported. No plants or animals on federal or state lists of endangered or threatened plants/wildlife are found in the 100-N Area. This characterization is representative of the geographical area defined by the facilities addressed in this EE/CA.

Before initiating a project on the Hanford Site, ecological reviews are required to ensure impacts to sensitive plant or animal species will not occur. Because the 100-N Area is highly disturbed, the only significant ecological issue is nesting birds protected by the *Migratory Bird Treaty Act of 1918*. Annual baseline reviews include surveys for nesting birds and a reconnaissance to determine if any sensitive plants are growing in the 100-N Area. Following the annual review, the project will be notified of any active nests or sensitive issues and appropriate actions to be taken.

2.1.4 Cultural Resources

The area along the Columbia River contains many cultural resources, including prehistoric and historic sites, Native American artifacts, and sites of religious significance (PNNL 2003). Three areas near the 100-N Area are known to have been of importance to the Wanapum Band located at Priest Rapids. Archaeological sites and traditional-use areas exist adjacent to the 100-N Area. Within the fence line around the 100-N Area, however, the likelihood of archaeological remains is remote because of the extensive ground disturbance resulting from construction of the 105-N Reactor and associated facilities. Intensive cultural resource surveys of the areas surrounding the 100-N Area were conducted during 1991 and 1995 (PNL 1992 and Andrefsky et al. 1996, respectively).

The N Reactor complex is considered a cultural resource. Thirty 100-N Area buildings/structures, including the 105-N Reactor Building and the 109-N Heat Exchanger Building, have been determined eligible for the National Register of Historic Places (NPS 1988) as contributing properties within the Historic District recommended for individual documentation. As required by the *Programmatic Agreement Among the U.S. Department of Energy Richland Operations Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site, Washington* (DOE-RL 1996), these eligible properties are documented on either Expanded Historic Property Inventory Forms or standard Historic Property Inventory Forms. The contribution these structures made to the Cold War is described in *The Hanford Site Historic District*, Chapter 2, Section 3, "Reactor Operations" (DOE-RL 2002b).

Physical effects to these eligible properties, up to and including demolition, have been mitigated. In compliance with the programmatic agreement, Stipulation V(C), the contents of these eligible properties were also evaluated to identify artifacts that may have interpretive or educational value as exhibits within local, state, or national museums. To complete the mitigation requirements under the programmatic agreement, these artifacts will need to be retrieved and transported to an appropriate curation facility before any demolition activities.

Prior to initiating a project on the Hanford Site, a cultural resource review is required to ensure that impacts to cultural resources will not occur. A cultural resources review will be performed in compliance with the requirements of the *National Historic Preservation Act of 1966* (NHPA) and the programmatic agreement (DOE-RL 1996) to address both the 105-N and 109-N facilities.

2.2 FACILITY AND WASTE SITE DESCRIPTIONS

Consistent with the remediation mission identified for the 100-N Area, the 105-N and 109-N facilities have been deactivated. Deactivation places the facilities in a safe and stable condition, minimizing the long-term cost of S&M and protecting workers, the public, and the environment. Deactivation includes removing all easily removable tools and equipment and performing facility decontamination. Decontamination of radiological and hazardous substances is accomplished by either removing materials that can be readily dislodged or by applying a fixative. This process prevents the spread of contamination during long-term storage and subsequent demolition activities.

This EE/CA addresses the 105-N and 109-N facilities, which were potentially contaminated with hazardous substances used in, or generated by, N Reactor operations. Information regarding hazardous substances used in these facilities is based primarily on process knowledge or construction material, historical operations, and process knowledge and sampling results of waste sites and facilities in the 100-N Area. This section provides a brief description and history of each facility. In addition, any 100-NR-1 OU waste sites that are present beneath and/or adjacent to the facilities included in this EE/CA are identified.

2.2.1 Building Descriptions

Descriptions of the 105-N and 109-N facilities are presented in the following subsections.

2.2.1.1 105-N Reactor Building. The N Reactor (105-N) is a 4,000-megawatt (thermal) nuclear reactor designed to operate as a dual-purpose reactor. The reactor core is a graphite-moderated, light water-cooled, horizontal pressure-tube facility designed to produce plutonium. By-product steam was routed to a nearby privately operated facility (185-N Hanford Generating Plant) to produce approximately 860 megawatts of electricity (DOE-RL 1997). Construction of N Reactor began in December 1959 and was completed in October 1963. N Reactor was the last of the Hanford Site graphite-moderated reactors. The facility contains the reactor block, front and rear elevators, pipe galleries, exhaust fans, a receiving basin for spent fuels, offices, control rooms, electrical and instrument rooms, a shop area, ventilation supply, metal preparation and storage areas, fuel storage basin, and a transfer area. On the south side of the building is the 109-N Heat Exchanger Building, which shares a common wall with 105-N. Asbestos, radiological, and chemical contamination exists in the 105-N Reactor Building.

The footprint of the 105-N facility is approximately 7,939 m^2 (85,450 ft^2) and includes three below-grade floor areas (minus 10-foot level, minus 16-foot level, and minus 21-foot level), main floor area (0-foot level), and four above-grade floor areas (plus 15-foot level, plus 28-foot level, plus 40-foot level, and plus 60-foot level). The roof is at the plus 70-foot level and also includes a penthouse structure that extends to 24 m (80 ft) above grade. The reactor core and other primary reactor support areas are constructed of reinforced concrete and mass shield walls. Interior walls are composed of steel frame, concrete block (concrete masonry unit), and insulated panel construction. The exterior of the building is covered with insulated corrugated-metal wall panels. The roof is covered with built-up roofing with felt strips near the edges and overcovered with urethane foam and two sealer coatings.

The reactor core is composed of interlocking graphite bars containing zirconium-alloy pressure tubes, which held the zirconium alloy-clad uranium-metal fuel elements. Reactivity and reactor power levels were controlled using horizontal control rods and a vertical ball-drop system. Boron was the primary neutron-absorbing material used in the control rods and ball-drop system.

The irradiated reactor fuel was discharged to the 105-N Fuel Storage Basin and placed into metal canisters. The fuel was cooled and stored in the basin to provide for radioactive decay of short-lived radionuclides before it was shipped for processing. The basin is an unlined, reinforced-concrete structure measuring 46 m (150 ft) long, 15 m (50 ft) wide, and 7 m (24 ft) deep.

Deactivation of the 105-N facility was completed in 1998, which included shutdown and isolation of operational systems, cleanup of radiological and hazardous waste, inventory of remaining hazardous materials, sealing access areas, and securing the facility. Contaminated hardware and equipment, sludge, and water were removed from the fuel storage basin. Concrete cover blocks were placed over the fuel storage basin to provide shielding and isolation. Although the deactivation has been completed, portions of the building remain as high-radiation areas and airborne radiation areas. In addition, lubricating oils and/or hydraulic fluids remain in some pieces of equipment (BHI 1998).

2.2.1.2 109-N Heat Exchanger Building. Construction of the 109-N Building began in December 1959 and was completed in October 1963. The 109-N and 105-N facilities share a common wall. The 109-N Building is being considered with the 105-N ISS due to structural integrity concerns over separating the two facilities and because of the high levels of radionuclide contamination within the piping systems and steam generator cells in the 109-N Heat Exchanger Building. Reactor primary coolant from 105-N was circulated through the reactor to steam generators located in the 109-N Heat Exchanger Building and then routed back to the reactor via primary coolant pumps. Steam from the steam generators was either dumped into water-cooled dump condensers or piped to the Hanford Generating Plant (HGP) to generate electricity. Circulation of the highly radioactive reactor primary coolant through 109-N caused equipment, piping, and steam generators to be contaminated similar to levels within the 105-N Reactor equipment and piping. Tube leaks in the 109-N Heat Exchanger Building's steam generators allowed radiologically contaminated primary water to be carried to the HGP's secondary systems. The HGP (185-N) along with a portion of the 1802-N pipe trestle that leads to the 185-N Building were demolished in 2003.

The 109-N facility is located on the south side of the 105-N Reactor immediately next to the building. The footprint of the building is approximately 8,406 m^2 (90,480 ft^2) and includes a below-grade floor area (minus 16-foot level), main floor area (0-foot level), and two above-grade floor areas (plus 15-foot level and plus 24-foot level). The roof is at the plus 38-foot level and also includes a penthouse structure that extends to 24 m (80 ft) above grade. The facility contains an auxiliary cell and six steam generator cells in parallel, each cell containing two steam generators, a drive turbine, a circulating pump and associated piping, valves, and instrumentation. Each steam generator is 17 m (57 ft) long by 3 m (10 ft) in diameter and weighs approximately 154 metric tons (170 tons). The 109-N Building includes a decontamination cell and a central penthouse area that contains a 13.5-m (44.5-ft)-high by 2-m (6.5-ft)-diameter pressure vessel weighing approximately 82 metric tons (90 tons). The building is constructed of reinforced concrete with metal siding on the exterior and polyurethane roofing material over a 10-cm (4-in.)-concrete slab. Interior walls are concrete block. The reinforced-concrete walls around the steam generator cells are approximately 1.5 m (5 ft) thick. The exterior of the building has eleven 1.8-m (6-ft)-diameter roof vents and the steam distribution headers and piping that routed pressurized steam to the 185-N HGP via the 1802-N pipe trestle.

Deactivation of the facility was completed in 1998, which included shutdown and isolation of operational systems, cleanup of radiological and hazardous waste, inventory of remaining hazardous materials, sealing access areas, and securing the facility. Although deactivation was completed, portions of the building (e.g., steam generator cells) remain as high-radiation areas and airborne radiation areas. The 109-N facility contains a large amount of asbestos and asbestos-containing materials that were primarily used for thermal insulation. In addition, lubricating oils and/or hydraulic fluids remain in some pieces of equipment (BHI 1998).

2.2.2 100-NR-1 Operable Unit Waste Sites

As discussed previously, the geographical area defined by the facilities addressed in the scope of this EE/CA includes a number of underlying and adjacent waste sites as summarized in Table 2-1.

Action sites are waste sites that require excavation in accordance with the selected remedy described in the 100-NR-1/100-NR-2 ROD (EPA 2000b) because they pose an unacceptable risk to human health and the environment based on an unrestricted-use scenario. Action sites also include the pipelines that are associated with the 1301-N and 1325-N TSD units, which are addressed in the TSD ROD (EPA 2000a).

In addition to action sites, a second site category is composed of ancillary facilities within the same geographical area as the 105-N and 109-N facilities. These ancillary facilities will be demolished and removed in their entirety. Disposition of these ancillary facilities is included in the *100-N Area Ancillary Facilities Hanford Site Action Memorandum, Hanford Site, Benton County, Washington* (EPA 1998).

2.3 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The source, nature, and extent of contamination within the 105-N and 109-N facilities is related to the specific operations conducted at each facility. In general, contamination in the 105-N Reactor Building resulted from activities associated with operation of a closed-loop, graphite-moderated, water-cooled reactor used to produce weapons-grade plutonium and steam for electric power generation. Activities conducted at the 105-N facility included storage and handling of green reactor fuel; general maintenance of the reactor systems; handling, storage, and shipping of irradiated reactor fuel; and collection and discharge of solid and liquid waste materials. These activities generated a variety of radioactive, nonradioactive hazardous, and mixed wastes in the 105-N Reactor Building. In addition, some other forms of hazardous material contamination (e.g., asbestos, lead shielding) are related to the structural components of the facility.

Contamination in the 109-N Heat Exchanger Building resulted from activities associated with the generation and transmission of steam to the HGP to generate electricity. Activities conducted at the 109-N facility included circulation of N Reactor primary coolant, operation of steam generators and dump condensers, discharge of steam to the HGP, equipment decontamination, and collection and discharge of solid and liquid waste streams. These activities generated a variety of radioactive, nonradioactive hazardous, and mixed wastes in the 109-N Heat Exchanger Building. In addition, some forms of contamination (e.g., asbestos, lead shielding) are related to the structural components of the facility.

To the extent practicable, hazardous substances (including bulk chemicals that are no longer in use) have been, removed from the facilities during deactivation, routine operations, and S&M. However, significant levels of radioactive contamination are still present in some locations in the facilities (e.g., reactor block, discharge elevator, fuel storage basin, piping systems, steam generators/cells, charge elevator pit, 3X ball recovery room, fission product trap) and residual contamination remains on facility surfaces (including the roof), in piping and ductwork, and in structural materials.

In general, the primary radioactive contaminants of concern include the following radionuclides (BHI 1997):

- Tritium (H-3)
- Carbon-14
- Cobalt-60
- Nickel-59, nickel-63
- Strontium-90
- Technetium-99
- Cesium-137
- Europium-152, europium-154
- Plutonium isotopes
- Americium-241.

The quantities of individual isotopes are not currently known but will be determined, as needed, through data quality objective-directed sampling and analysis tasks before disposal.

The facilities also contain nonradioactive hazardous substances as either contaminants from operations or components of structural materials. These substances include the following:

- Friable and nonfriable forms of asbestos
- Lead paint
- Lead shielding
- Polychlorinated biphenyls (PCBs) (e.g., light ballasts)
- Mercury (in switches, gauges, and thermometers)
- Refrigerants (freon)
- Petroleum products
- Water treatment products
- Lubricants
- Corrosives
- High-efficiency particulate air filter media
- Sodium-vapor and mercury-vapor lighting.

The concentrations of nonradioactive contaminants are not currently known but will be determined, as needed, through data quality objective-directed sampling and analysis tasks before disposal.

2.4 RISK EVALUATION AND SITE CONDITIONS THAT JUSTIFY A REMOVAL ACTION

The 105-N and 109-N facilities are known to be contaminated with radioactive and/or nonradioactive hazardous substances. In some locations in the facilities (e.g., reactor block, discharge elevator, fuel storage basin, piping systems, steam generators/cells, 3X ball recovery room, fission product trap) the levels of radioactive contamination are significant. The risks associated with the radioactive and nonradioactive contaminants have not been quantified. The following discussion provides a qualitative discussion of the risks.

The primary contaminants of concern for the 105-N and 109-N facilities are radiological. The facilities have been deactivated and decontaminated to some extent, but the levels of radioactive contamination that remain are significant, particularly in some portions of the facilities. Hazardous substances, including asbestos insulation, heavy metals (e.g., mercury in switches, lead shielding), and PCBs in building materials, are also present in the facilities.

A security fence currently surrounds the 100-N complex to limit unauthorized entrance. In addition, the facilities are locked and require entry approval from the Facilities Decommissioning Project. As long as the DOE retains control of the 100 Areas, these institutional controls would prevent direct contact with and exposure to the hazardous materials. However, institutional controls will not prevent deterioration of the facilities and potential release of contaminants to the environment. Contaminants could be released directly to the environment via a breach in a pipe, containment wall, roof, or other physical control as the facilities age and deteriorate. Contaminants could also be indirectly released to the environment through animal intrusion into the contaminated structures and systems. Historically, intrusion and spread of contamination by rodents, insects, birds, and other organisms has been difficult to control and prevent.

The current threat of a release of contaminants from the 105-N and 109-N facilities is relatively low. Consequently, the risk to the public and environmental receptors is low. However, as the facilities continue to age and deteriorate, the threat of potential release of radiological and hazardous substances increases, and it becomes more difficult to confine these materials from the environment. The S&M activities required to confine the hazardous substances inside the facilities (e.g., reactor block, fuel storage basin, steam generators) may increase the risk of potential exposure to personnel. The potential exposure to workers and wildlife, the threat of future releases, and the risks associated with contamination at the 105-N and 109-N facilities justify a non-time-critical removal action.

Table 2-1. Summary of 100-NR-1 Operable Unit Waste Sites Within the Engineering Evaluation/Cost Analysis Geographical Area.

Site Status	WIDS Site	Description	CERCLA Decision Document
Action sites	UPR-100-N-10	Lift station gravity drain line	TSD ROD (EPA 2000a)
	UPR-100-N-35	105-N Fuel Storage Basin drainage system leak	TSD ROD (EPA 2000a)
	100-N-37	109-N asbestos release	TSD ROD (EPA 2000a)
	100-N-62	100-N, 105-N, 109-N, 163-N, 183-N, and 184-N underground pipelines	TSD ROD (EPA 2000a)
	100-N-64	105-N Reactor/109-N cooling water effluent underground pipelines	TSD ROD (EPA 2000a)
	100-N-29	Unplanned release on 25-cm blowdown pipeline #1	100-NR-1/100-NR-2 ROD (EPA 2000b)
	100-N-30	Unplanned release on 10-in. blowdown pipeline #2	TSD ROD (EPA 2000a)
	100-N-31	Unplanned release on 30-in. pipeline	TSD ROD (EPA 2000a)
	100-N-32	Unplanned release on 25-cm blowdown pipeline #3	TSD ROD (EPA 2000a)
	100-N-38	Unplanned release at 1300-N	TSD ROD (EPA 2000a)
	UPR-100-N-14	119-N drain system leak	TSD ROD (EPA 2000a)
	UPR-100-N-12	Spacer transport line leak	TSD ROD (EPA 2000a)
	UPR-100-N-3	Dummy fuel transfer line leak	TSD ROD (EPA 2000a)
	UPR-100-N-39	Corridor 22 suspect liquid unplanned release	TSD ROD (EPA 2000a)
	UPR-100-N-9	119-N cooling water drain line leak	TSD ROD (EPA 2000a)
	100-N-63	TSD underground pipelines	TSD ROD (EPA 2000a)
Facilities	--	105-NA emergency diesel enclosure	*Action Memorandum for the 100-N Ancillary Facilities* (Ecology et al. 1999)
	--	105-NE fission products trap	*Action Memorandum for the 100-N Ancillary Facilities* (Ecology et al. 1999)
	--	1605-NE observation post	*Action Memorandum for the 100-N Ancillary Facilities* (Ecology et al. 1999)
	--	1722-N decontamination building	*Action Memorandum for the 100-N Ancillary Facilities* (Ecology et al. 1999)

WIDS = Waste Information Data System

3.0 REMOVAL ACTION OBJECTIVES

The 105-N Reactor Building and 109-N Heat Exchanger Building pose a threat to human health and the environment. The facilities contain radioactive and nonradioactive hazardous substances as surface contamination, matrix contamination, or within structural components. The removal action shall be conducted in a manner that is protective of human health and the environment.

The scope of this removal action addresses only the 105-N and 109-N facilities. The soil underlying some of the facilities may also be contaminated. Where there is previous knowledge of such contamination, the soil has already been identified as a separate waste site and will be remediated under the authority of the 100-NR-1/100-NR-2 ROD (EPA 2000b). For purposes of this EE/CA, it is assumed that in the absence of known soil contamination, the soil underlying a facility is clean (i.e., meets unrestricted use cleanup standards for the 100 Area). If threats associated with the underlying soil are identified in the future, they will be addressed during final disposition of N Reactor.

Based on the potential hazards identified in Sections 2.3 and 2.4, the following removal action objectives have been identified:

- Control the migration of contaminants from the facilities to the environment
- Protect human receptors from exposure to contaminants in facility structures above acceptable exposure levels
- Facilitate remediation of 100-N Area waste sites in accordance with the TSD ROD (EPA 2000a)
- Prevent adverse impacts to cultural resources and threatened or endangered species
- Achieve applicable or relevant and appropriate requirements (ARARs) to the fullest extent practicable
- Safely treat, as appropriate, and dispose of waste streams generated by the removal action
- Support actions for the final disposition of the 105-N Reactor block.

4.0 REMOVAL ACTION ALTERNATIVES

The removal action alternatives for the 105-N and 109-N facilities must be protective of human health and the environment and must not inhibit future implementation of remedial action operations for 100-NR-1 OU waste sites located in the same geographical area. The removal action alternatives must also not prevent or inhibit the final disposition of the N Reactor core.

As presented in Section 2.0, the principal threats to be addressed in the selection of a removal action alternative are radioactive and/or nonradioactive hazardous substances contained in and around the facilities. Deactivation of the 105-N and 109-N facilities has been completed. All accessible tools, equipment, and waste materials have been removed from the facilities and disposed. Some decontamination has been completed, and fixatives have been applied to prevent the spread of contamination. However, significant contamination remains, especially in portions of the facilities and equipment associated with the reactor primary coolant system. Structures (or portions of the structures) associated with the 105-N and 109-N facilities will be removed or otherwise addressed to facilitate implementation of the selected removal action. An aerial photograph of the 105-N Reactor and the 109-N Heat Exchanger Building is provided in Figure 4-1.

4.1 PROPOSED REMOVAL ACTION ALTERNATIVES

Based on the above considerations, the following three removal action alternatives were identified for the facilities:

- Alternative one: No action
- Alternative two: ISS of the N Reactor complex (105-N and 109-N) followed by long-term S&M, with D&D of the 109-N steam generator cells and pipe gallery performed in conjunction with final disposition of the 105-N Reactor block.
- Alternative three: Long-term S&M followed by full D&D of the 109-N facility and partial D&D of 105-N up to the reactor shield walls in preparation for final disposition.

Since the N Reactor was not included in the *Final Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site* (DOE 1992) with the other Hanford Site surplus reactors, the DOE will need to develop additional NEPA documentation to establish a final disposition for the 105-N Reactor block.

The following sections describe each of the alternatives listed above.

4.2 ALTERNATIVE ONE – NO ACTION

Evaluation of a no action alternative is required to provide a baseline for comparison with other active alternatives. Under the no action alternative, facility ISS activities would not be performed and current S&M activities would be discontinued. Hanford Site institutional controls (e.g., fencing, posted signs) would be maintained to help warn of hazards and control worker and public access to the facilities. No other specific controls would be established for the facilities covered by this EE/CA. Because the facilities would not be decontaminated, and no action would be taken to stop the facilities from deteriorating, there would be an increased threat and likelihood for a release of hazardous substances, potentially exposing workers, the public, or the environment. In addition, the no action alternative would impede remedial action progress for the 100-NR-1 OU waste sites located in the geographical area.

There is no cost associated with the no action alternative.

4.3 ALTERNATIVE TWO – INTERIM SAFE STORAGE OF THE N REACTOR COMPLEX

Alternative two would consist of performing ISS of the 105-N Reactor Building and the 109-N Heat Exchanger Building. Limited S&M of the 105-N and 109-N safe storage enclosures (SSEs) would follow ISS activities. D&D of the remaining portions of 109-N (piping gallery and steam generator cells) would be performed after the long-term S&M period.

ISS of 105-N and 109-N would consist of performing D&D of portions of the facilities and construction of an SSE over the 105-N Reactor block and the 109-N steam generator cells and pipe gallery. The 109-N facility is being considered for ISS with the 105-N facility because contact with the primary reactor coolant within the 109-N piping systems and steam generator cells resulted in high levels of radionuclide contamination in the 109-N facility, and due to concerns over the structural integrity of separating the two facilities. ISS would prevent advanced structural deterioration and potential release of radionuclides or other hazardous substances. Figure 4-2 provides a depiction of the completed ISS of the N Reactor complex.

The goal of ISS would be to cost-effectively ensure durable and long-term facility storage in a manner that is protective of human health and the environment. The ISS alternative would be implemented as described in the following subsections.

4.3.1 Decontamination and Decommissioning of Portions of the 105-N and 109-N Facilities

The first stages of this alternative would consist of assessment, decontamination, and demolition of portions of the 105-N and 109-N facilities. All portions of the 105-N facility outside of the reactor shield walls would undergo D&D. This includes all of the rooms and shops from the minus 16-foot elevation to the plus 28-foot elevation and the entire plus 40-foot and plus 60-foot elevation areas. This would also include the 105-N Fuel Storage Basin and loadout facilities.

Removal of the storage basins would result in a significant reduction of radiological contamination in the facility. Contaminated below-grade structures and underlying soil would be removed and disposed, as needed. Uncontaminated below-grade structures may be stabilized in place. Figure 4-3 shows the floor plan of the 0-foot elevation and identifies the reduced footprint of the 105-N facility after ISS is completed.

For the 109-N facility, all portions of the 109-N facility outside of the shield walls encompassing the steam generator cells and pipe gallery would undergo D&D. This includes all of the rooms and shops from the minus 16-foot elevation to the plus 24-foot elevation areas as well as the external steam distribution piping and subgrade cooling water distribution piping directly south of the facility. This would also include D&D of the decontamination cell, pressurizer tank system, and the penthouse structure surrounding the pressurizer tank. Contaminated below-grade structures and underlying soil would be removed and disposed, as needed. Uncontaminated below-grade structures may be stabilized in place. Figure 4-4 shows the floor plan of the 0-foot elevation and identifies the reduced footprint of the 109-N facility after ISS is completed.

Assessment would consist of radiological surveys and sampling, characterization, and preparation of all engineering and safety documents and work packages to perform the field activities.

Decontamination could be accomplished through a variety of methods, such as scabbling or scaling. In general, when physical removal of contaminants is not feasible or cost effective, the contamination would be "fixed" so that the contaminants would remain attached to the construction materials and would be less likely to be disturbed during subsequent demolition activities. Methods of fixing contaminants in place include painting, applying asphalt, and spreading plastic sheeting. Specific to preparation for ISS, loose contamination would be removed or fixed to the greatest extent feasible in accessible areas within the shield walls that form the outside vertical sections of the ISS structure.

Facility decontamination would be used to ensure worker safety by minimizing potential exposure during D&D. Decontamination would also reduce the potential for contaminated fugitive emissions. In addition, decontamination would reduce the protection required during D&D and potentially reduce waste volumes, thus reducing overall removal and disposal costs.

After decontamination processes are completed, facility components, piping, ducting, and equipment may be dismantled and removed for disposal. Demolition generally means large-scale facility deconstruction using heavy equipment (e.g., wrecking ball, excavator with a hoe-ram, shears, concrete pulverizer), explosives, or other industrial methods. Demolition methods would be selected based on the structural elements to be demolished, remaining radionuclide contamination, location, and integrity of the facility structure. Dust-suppression techniques would be employed during demolition activities.

4.3.2 Residual Contamination

The degree to which subsurface structures and any contaminated soil would be addressed during D&D would depend on a number of factors. One factor would be proximity to other waste sites. As described in Section 2.2.2, the 105-N and 109-N facilities are adjacent to waste sites for which remediation is planned or underway. In those instances where an interaction between the facilities and a waste site occurs, the subsurface structures and soil at the facility would be addressed in coordination with those waste sites using the applicable ROD and cleanup standards for those sites.

If feasible, subsurface structures and contaminated soil would be characterized and evaluated at the time of D&D in accordance with the remedial action objectives and cleanup standards as specified in the 100-NR-1/100-NR-2 ROD (EPA 2000b). This would involve sampling subsurface materials to determine if they meet the cleanup standards for protection of human exposure via direct contact and protection of groundwater and the Columbia River. If soil contamination is known or suspected, the soil underlying the site would be characterized and evaluated against the cleanup standards. If the below-grade structures meet the cleanup standards as specified in the ROD, the remaining structures would be left in place. Structural materials or soil that exceed cleanup standards would be removed and disposed of at the Environmental Restoration Disposal Facility (ERDF).

If it were not feasible to remediate below-grade structures and soil at the time of D&D, the site would be identified as a discovery site in the Hanford Site waste site database. Disposition of these sites would then be deferred to the Remedial Action Project, at which time they would be remediated in accordance with the appropriate 100 Area ROD.

For the 105-N Fuel Storage Basin, it is anticipated that the subsurface structure and underlying soil would be addressed as part of D&D in accordance with the processes described previously. The remaining portion of the basin will be removed as part of D&D and disposed of at the ERDF or other approved facility. The basin structure would be sampled and characterized, as would the underlying soil. Upon completing D&D activities, a minimum of 1 m (3 ft) of clean fill/soil cover would be placed over any remaining below-grade structures and inert demolition material and would be graded to meet the surrounding terrain in such a manner that minimum infiltration of run-off precipitation would occur.

The decontamination cell, subsurface structure, and underlying soil would be addressed as part of D&D of the 109-N facility and disposed of at the ERDF or other approved facility. The structure would be sampled and characterized, as would the underlying soil. Upon completing D&D activities, a minimum of 1 m (3 ft) of clean fill/soil cover would be placed over any remaining below-grade structures and inert demolition material and would be graded to meet the surrounding terrain in such a manner that minimum infiltration of run-off precipitation would occur.

4.3.3 Constructing the Safe Storage Enclosures on the 105-N and 109-N Facilities

The SSE structures will be designed and built to completely enclose the roof sections of the 105-N and 109-N facilities. The SSE will consist of a self-supporting, structural-steel frame covered with metal roofing. Side panels avot the shield walls will be covered with metal siding. All openings and penetrations within the shield walls and on top of the reactor would be closed. Large openings would be sealed by concrete pourbacks; and welded caps, foam sealant, or plugs would close smaller openings and penetrations.

For the 109-N facility, the existing steam generator/pipe gallery shield walls and roof, constructed of 1.5-m (5-ft)-thick reinforced concrete, would be used as the primary enclosure for safe storage. After D&D of the 109-N facility turbine drive bay, steam and cooling water distribution piping, decontamination cell, and pressurizer penthouse areas, a new metal roof would be constructed to enclose the top of the remaining structure. The roof would consist of structural steel and metal roof decking designed to meet the ISS storage period of 64 years (the roof has a 75-year design life). The steam generator/pipe gallery walls would support the roof. Openings between the new roof and top of the steam generator/pipe gallery walls would be enclosed with wall panel siding similar to that on the new roof. Openings and penetrations within the steam generator/pipe gallery walls would be closed. Large openings would be sealed by concrete pourbacks; and welded caps, foam sealant, or plugs would close smaller openings and penetrations.

The 105-N/109-N ISS design will "enclose" the reactor block and the steam generator cells, leaving only the high-radiation portions of the facilities with very limited access. All surveillance paths into the ISS would be through high-radiation areas. Necessary ventilation ducting would be installed inside the SSE that would be connected to an external port, allowing the use of a portable exhaust unit if required. A remote monitoring system with primary and backup sensors for each monitor point would be installed inside the reactor enclosure so that key parameters will be monitored. The equipment associated with monitoring and electrical power and lighting would be installed in a utility room located outside of the SSE so that entry into the SSE would not be necessary to service this portion of the equipment or change to a backup sensor if the primary unit fails. If the remote monitoring equipment records a problem within the enclosure that requires physical inspection within the enclosure, an emergency condition occurs, or servicing the remote sensors is required, provisions will be incorporated into the SSE design to facilitate these entries.

4.3.4 Long-Term Surveillance and Maintenance of the Safe Storage Enclosure Structures

Long-term S&M would be required only for the SSE structures. The monitoring following ISS will be accomplished remotely, and maintenance activities would be performed on the SSE exterior (e.g., roof inspections, structural integrity inspections, and external radiological surveys). Remote monitoring data evaluations will be routinely performed to ensure there is no water or biological intrusion or spread of contamination. Entry into the facility would occur only if one of the remote monitors indicated a system failure, emergency conditions warranted entry, or the remote monitoring system recorded a problem that required physical inspection. For the purposes of this document, the schedule for disposition of the 105-N Reactor block is assumed to be consistent with the other eight Hanford Site reactors. The *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999) calls for final disposition of the eight surplus Hanford Site reactors to be accomplished by 2068. Therefore, S&M would be assumed to occur until final disposition of the reactor block, which is within approximately 64 years. By design, the SSE structure would require minimal surveillance. It would be equipped with remote monitoring equipment that allows surveillance of key parameters (humidity and temperature) within the enclosure. The design of the SSE would be such that no significant maintenance would be required.

4.3.5 Decontamination and Decommissioning of the 109-N Steam Generator Cells and Pipe Gallery

Under this alternative, D&D of the 109-N steam generator cells and pipe gallery would be performed at the conclusion of the long-term S&M period after much of the radioactivity contained within these areas has been allowed to decay to lower levels. Decontamination, demolition, and management of remaining subsurface structures could be accomplished as described in previous sections. Equipment and structures in the steam generator cells will be decontaminated to the extent practical to prepare the materials for demolition and disposal. The south walls of each of the steam generator cells will be demolished to facilitate removal of piping, equipment, and the steam generators. The steam generators will be removed from the cells on skids, prepared for disposition, loaded onto a transporter, and transported to the ERDF for disposal. The remaining contaminated structures will be demolished and disposed. Subsurface structures and soil at the facility would be addressed in coordination with the 100-NR-1 waste sites using the applicable ROD and cleanup standards for those sites.

4.3.6 Present-Worth Cost

Table 4-1 shows the present-worth cost estimate for alternative two. This estimate includes cost estimates for partial demolition and/or stabilization of the structural portions of both the 105-N and 109-N facilities up to the shield walls. The estimates include design and construction of the SSE structures for both the 105-N and 109-N facilities and long-term surveillance until 2068. The final portion of the cost estimate shows costs for final D&D of the 109-N steam generator cells and pipe gallery in preparation for final disposition of the reactor block.

4.4 ALTERNATIVE THREE – SURVEILLANCE AND MAINTENANCE OF THE 105-N AND 109-N FACILITIES

Alternative three would consist of S&M of the 105-N and 109-N facilities to maintain minimum safe conditions until final disposition of the 105-N facility is determined. D&D of the 109-N facility will be performed prior to initiating final disposition of the 105-N facility. Alternative three also includes activities to perform D&D of the 105-N facility up to the reactor shield walls. The 105-N D&D activities are included in this alternative to provide a more consistent comparison of costs between alternative two and alternative three.

S&M would be assumed to occur until final disposition of the 105-N Reactor block, which is within approximately 64 years (DOE 1999). Current Tri-Party Agreement Milestone M-93-20 requires ISS of the 105-N Reactor by 2012. Tri-Party Agreement Milestone M-93-20 would need to be modified or cancelled in order to implement this alternative.

4.4.1 Long-Term Surveillance and Maintenance of the 105-N and 109-N Facilities

During the S&M phase of this alternative, existing institutional controls would be maintained to warn area workers of potential hazards and restrict public access to the N Reactor complex. Access to the 105-N and 109-N facilities would be restricted for nonradiological workers. The S&M measures would include routine radiological and hazard monitoring of the facilities, periodic safety inspections, and basic facility maintenance (as required) based on the condition of each specific facility. Activities would be balanced to reduce worker hazards and the potential for contaminant release. Major repairs (e.g., repair/replace roof, shore structural components) would be performed as necessary to ensure facility integrity for containment of hazardous substances within the structure.

In general, as facilities age and deteriorate, S&M must become more aggressive over time, and worker safety is a critical factor. Without an increasingly aggressive S&M program, the threats associated with unplanned releases to the environment and injury or exposure to workers would increase. Conversely, an aggressive S&M program would require more frequent worker entry into the facilities to perform more invasive maintenance procedures, which would increase the potential for exposure to workers. In addition, personal protection requirements to maintain a more aggressive program could continually increase, which would add to the cost. Because the S&M phase of this alternative could continue until 2068, the level of S&M activities required can be expected to increase in the later years of the action due to the compounding, cumulative effect of natural deterioration of the structures. A need for upgrades to the infrastructure (e.g., electrical, sewer, water systems) would also be anticipated in the outyears of the S&M period.

A variety of waste streams would be generated in the performance of S&M, which would be characterized, packaged, and disposed. Waste that meets the *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (BHI 2002) would be disposed of at the ERDF or another regulator-approved disposal facility. Other wastes would be managed to comply with identified ARARs as described in Section 4.5.

4.4.2 Decontamination and Decommissioning of the 109-N Facility

The entire 109-N facility would undergo assessment and decontamination and demolition prior to initiating final disposition of the 105-N facility (approximately 2068). All portions of the 109-N facility, including the steam generator cells, pipe gallery, decontamination cell, and pressurizer tank system, would undergo D&D up to the common reactor shield wall that separates the 105-N facility from the 109-N facility. This includes all of the rooms and shops from the minus 16-foot elevation to the plus 24-foot elevation areas as well as the external steam distribution piping and subgrade cooling water distribution piping directly south of the facility. Contaminated below-grade structures and underlying soil would be removed and disposed, as needed. Uncontaminated below-grade structures may be stabilized in place. The area would be backfilled to its original grade to minimize infiltration of precipitation.

Assessment would consist of radiological surveys and sampling, characterization, and preparation of all engineering and safety documents and work packages to perform the field activities.

Decontamination could be accomplished as described in Section 4.3.1. In preparation for D&D, loose contamination would be removed or fixed to the greatest extent feasible in accessible areas. Facility decontamination would be used to ensure worker safety by minimizing potential exposure during D&D. Decontamination would also reduce the potential for contaminated fugitive emissions.

After decontamination processes are completed, facility components, piping, ducting, and equipment may be dismantled and removed for disposal. Demolition would proceed using heavy equipment (e.g., wrecking ball, excavator with a hoe-ram, shears, concrete pulverizer), explosives, or other industrial methods. Demolition methods would be selected based on the structural elements to be demolished, remaining radionuclide contamination, location, and integrity of the facility structure. Dust-suppression techniques would be employed during demolition activities.

4.4.3 Decontamination and Decommissioning of the 105-N Facility up to the Shield Walls

This element of alternative three would consist of assessment, decontamination, and demolition of portions of the 105-N facility. All portions of the 105-N facility outside of the reactor shield walls would undergo D&D. This includes all of the rooms and shops from the minus 16-foot elevation to the plus 28-foot elevation and the entire plus 40-foot and plus 60-foot elevation areas. This would also include the 105-N Fuel Storage Basin and loadout facilities. Contaminated below-grade structures and underlying soil would be removed and disposed as needed. Uncontaminated below-grade structures may be stabilized in place. Assessment, decontamination, demolition, and management of remaining subsurface structures could be accomplished as described in Section 4.3.1. The area would be backfilled to original grade per the discussion in Section 4.4.2.

4.4.4 Residual Contamination

Subsurface structures and contaminated soil would be addressed during D&D in the same manner as discussed in the previous section. Subsurface structures and soil at the facility would be addressed in coordination with those waste sites using the applicable ROD and cleanup standards for those sites. Subsurface structures and contaminated soil would be characterized and evaluated at the time of D&D in accordance with the remedial action objectives and cleanup standards as specified in the 100-NR-1/100-NR-2 ROD (EPA 2000b). If soil contamination is known or suspected, the soil underlying the site would be characterized and evaluated against the cleanup standards.

If the below-grade structures meet the cleanup standards as specified in the 100-NR-1/100-NR-2 ROD, the remaining structures would be left in place. Structural materials or soil that exceed cleanup standards would be removed and disposed of at the ERDF or another regulator-approved disposal facility. If it is not feasible to remediate below-grade structures and soil at the time of D&D, the site would be identified as a discovery site in the Hanford Site waste site database. Disposition of these sites would then be deferred to the Remedial Action Project, at which time they would be remediated in accordance with the appropriate 100 Area ROD.

4.4.5 Present-Worth Cost

Table 4-2 shows the present-worth cost estimate for implementing alternative three. The cost of S&M for both facilities was estimated through 2068 using the actual S&M costs incurred for these facilities during fiscal year 2003. The cost of the S&M program for the 105-N and 109-N facilities during fiscal year 2003 was approximately $250,000. This includes all management and overhead costs to operate the program.

Roofs typically require replacement or resurfacing approximately every 10 years. For the purposes of this EE/CA, it was assumed that re-roofing would be necessary six times during the 64-year S&M period. The cost of re-roofing the facilities was estimated based on the total square-foot area of the building roofs times $15 per square foot. Waste disposal costs were estimated based on cubic meters of waste generated times $105 per cubic meter for disposal. This cost estimate corresponds to actual costs incurred for repairing/replacing roofs on radioactive facilities on the Hanford Site.

4.5 COMMON ELEMENTS

Common elements that are shared between alternatives two and three include historical property management and waste management as discussed in the following subsections.

4.5.1 Historical Properties Management

As presented in Section 2.0, both of the facilities meet the NHPA criteria for consideration as historically significant properties. Assessments of the properties have been completed. Physical effects to these eligible properties, up to and including demolition, have been mitigated. Artifacts marked for retention would need to be retrieved and transported to an appropriate duration facility selected by RL before any demolition activities occurred.

4.5.2 Waste Management

Alternatives two and three would each generate waste that requires disposal at appropriate disposal sites. Waste management would be a common element for those alternatives.

Under each alternative, personnel would evaluate opportunities for waste minimization and pollution prevention, when economically feasible, for releasable material to reduce the volume of material disposed. Inert uncontaminated and decontaminated rubble and other miscellaneous structural material that could not be recycled may be used to fill void spaces in the below-grade structures following demolition. Materials that can be effectively decontaminated and noncontaminated waste that can be effectively segregated from contaminated waste would be recycled or sent to an approved offsite facility for disposal. As an alternative, noncontaminated waste could be considered for use as fill material at the Hanford Site with prior approval from the Tri-Parties. Noncontaminated liquids that are encountered during the removal action could be used for dust suppression.

Waste for which no reuse, recycle, or decontamination options are identified would be assigned an appropriate waste designation (e.g., solid, asbestos, PCB, radioactive, dangerous, or mixed) and disposed of accordingly. The preferred pathway for disposal of contaminated waste would be the ERDF. Construction and operation of the ERDF was authorized via the *Record of Decision for the Environmental Restoration Disposal Facility* (ERDF ROD) (EPA 1995). The ERDF is an engineered structure designed to meet RCRA minimum technological requirements for landfills, including standards for a double liner, a leachate collection system, leak detection, and a final cover.

In 1996, an explanation of significant difference (Ecology et al. 1996) clarified the ERDF ROD (EPA 1995) for eligibility of waste generated during Hanford Site cleanup activities. In accordance with the explanation of significant difference, any low-level waste, mixed waste, and hazardous/dangerous waste generated as a result of CERCLA or RCRA cleanup actions (e.g., D&D, RCRA past-practice, and investigation-derived wastes) is eligible for ERDF disposal, provided that appropriate CERCLA decision documents are in place and that the waste meets ERDF waste acceptance criteria (BHI 2002). Consequently, contaminated waste generated during the removal action proposed in this EE/CA would be eligible for disposal at the ERDF. Previous EE/CAs for other Hanford Site facilities have shown that the ERDF provides a high degree of protection for human health and the environment and is more cost effective than other disposal site options for comparable waste. Estimated waste volumes that would be generated for disposal at ERDF would not be expected to significantly impact ERDF capacity limitations. The waste volumes in this document have been taken into account for ERDF planning purposes. Further discussions of the construction and operation of the ERDF are not within the scope of this EE/CA, but are available in the ERDF ROD (EPA 1995).

While most waste generated during the removal action is anticipated to meet the ERDF waste acceptance criteria (BHI 2002), some waste may require treatment before disposal. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques such as macroencapsulation or grouting. For waste that cannot be sent to the ERDF, it is expected that treatment, storage, and disposal can occur at other Hanford Site facilities such as the Central Waste Complex or the Effluent Treatment Facility. If waste were encountered that must be sent offsite for treatment or disposal, the EPA would make an acceptability determination for proposed facilities in accordance with 40 CFR 300.440.

Figure 4-1. Aerial Photograph of the N Reactor Complex During Operation (Circa 1985).

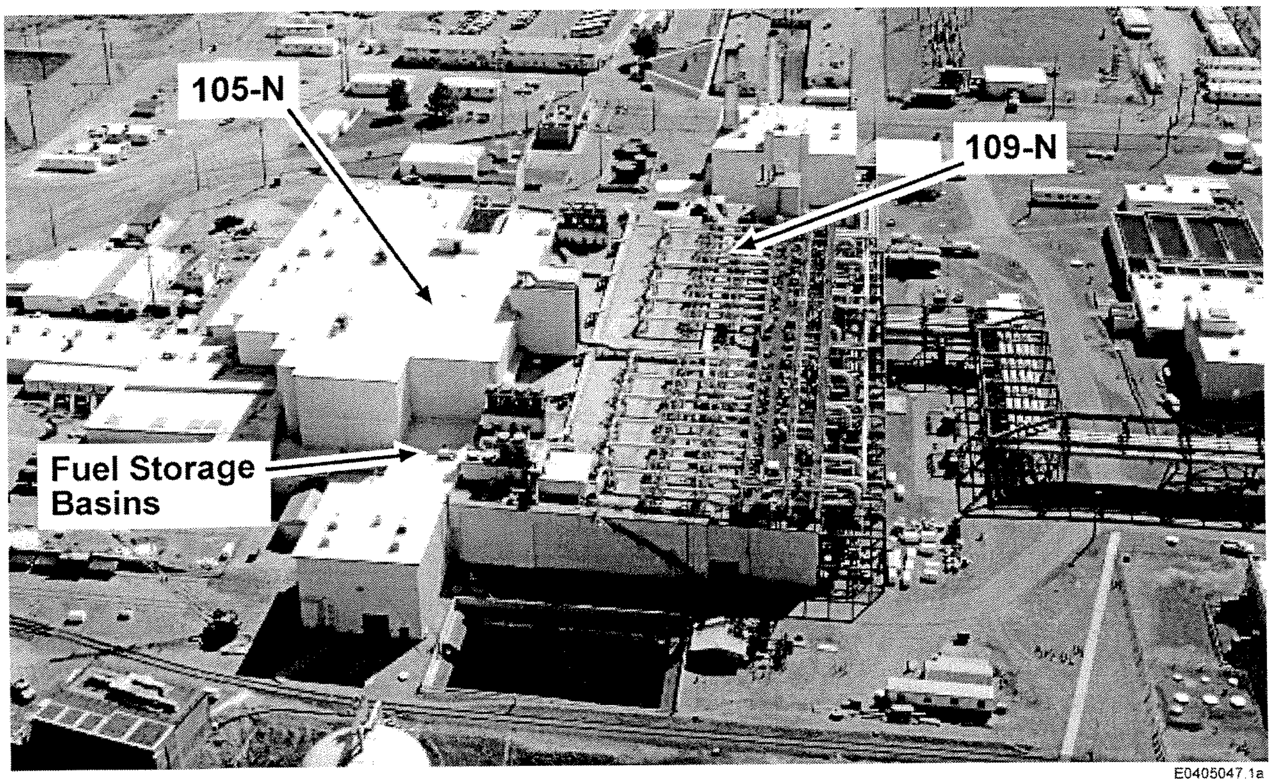


Figure 4-2. Conceptual Diagram of the N Reactor Complex After Interim Safe Storage of the 105-N and 109-N Facilities.

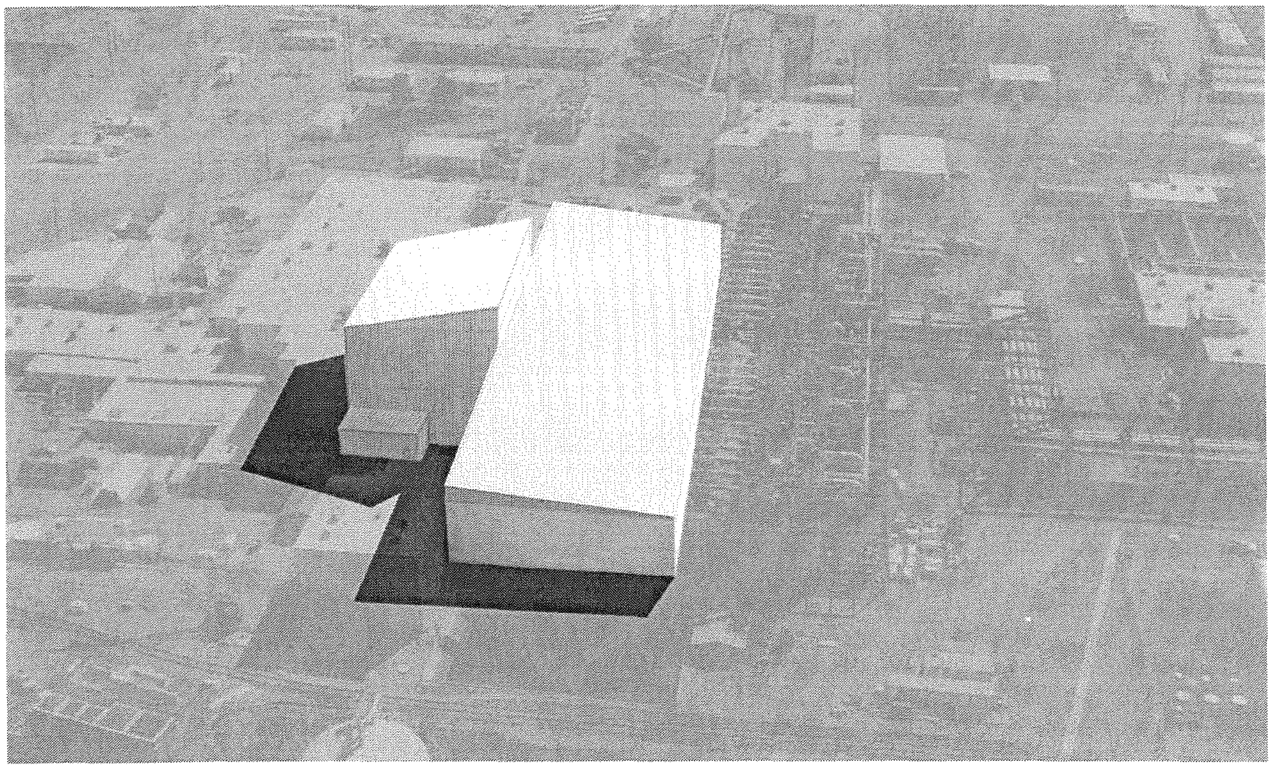
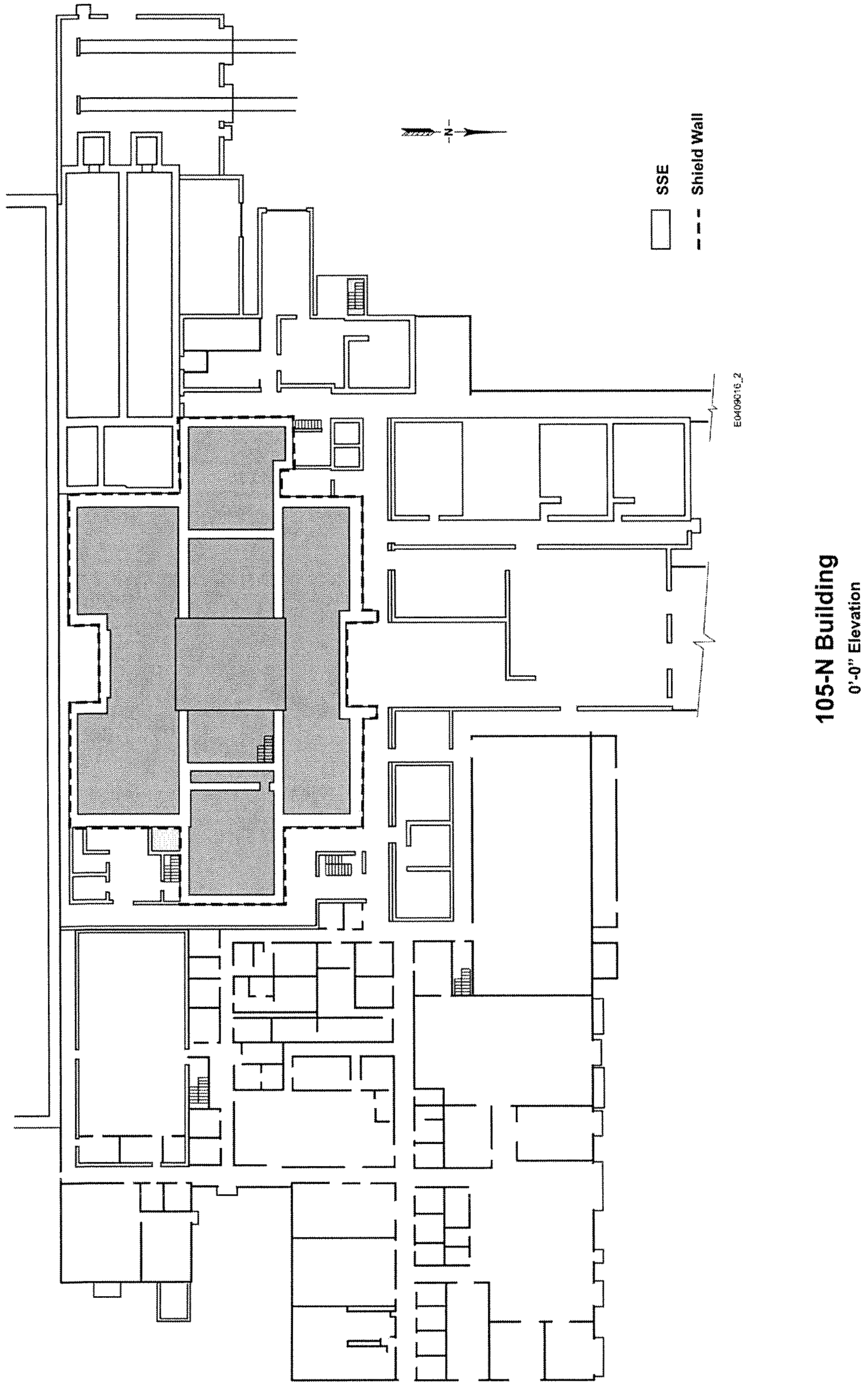


Figure 4-3. 105-N Floor Plan, 0-Foot Elevation.



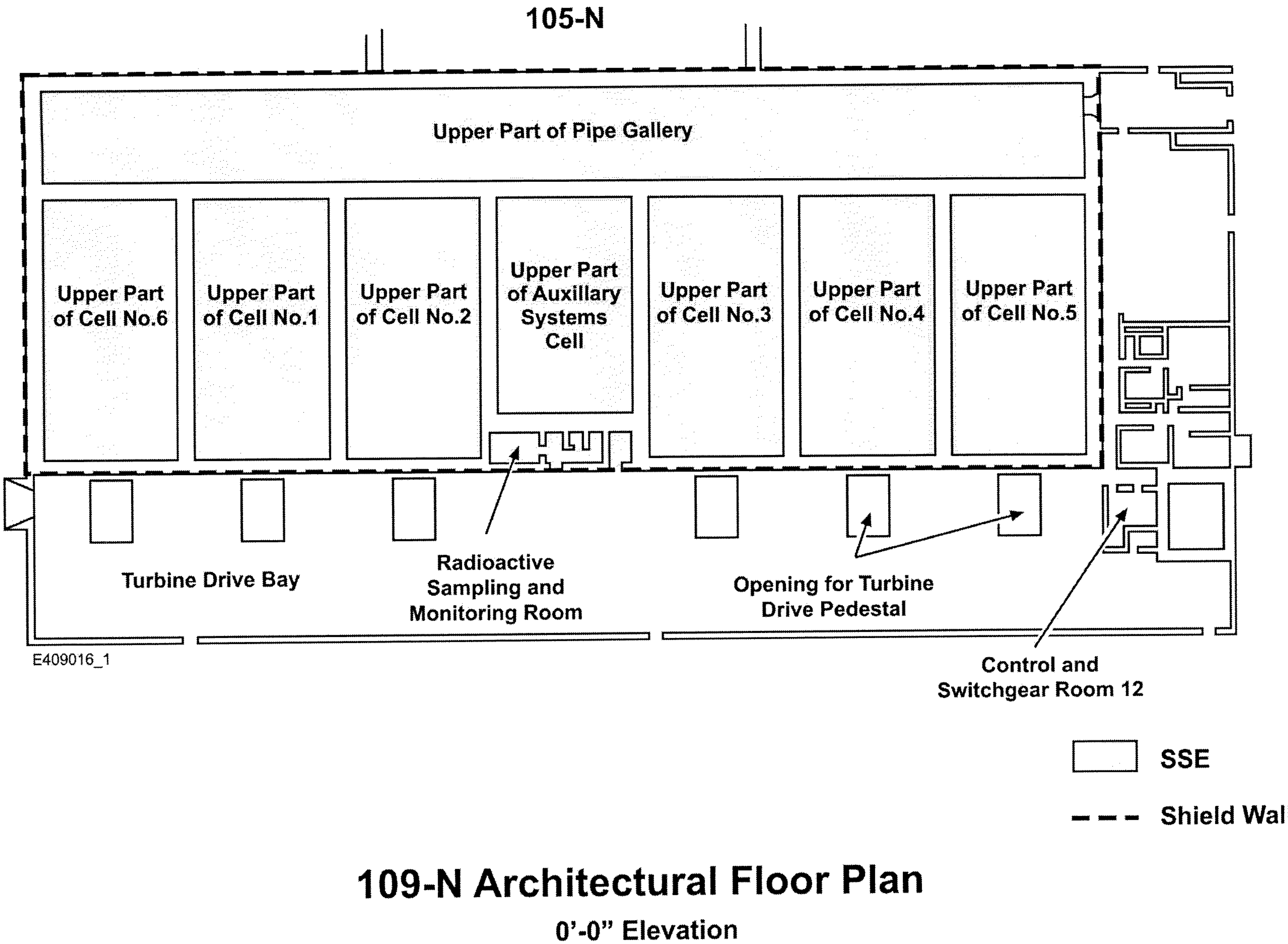


Figure 4-4. 109-N Floor Plan, 0-Foot Elevation.

Table 4-1. Cost Estimate for Alternative Two (2004 Dollars).

Description of Costs	Estimated Cost ($)[a]
Interim Safe Storage of the 105-N Reactor Building	
Equipment	$2,279,000
Labor	$11,926,000
Materials	$304,000
Allowance for high radiation work	$1,700,000
ODCs	$1,226,000
Subcontract costs (SSE)	$1,036,000
Subtotal	**$18,471,000**
Support and indirect costs (12%)	$2,217,000
Direct distributables (18.68%)	$3,864,000
G&A (4.98%)	$1,223,000
Contingency (27.7%)	$7,140,000
Long-term surveillance and maintenance[b]	$960,000
105-N ISS Total	**$33,875,000**
Interim Safe Storage of the 109-N Heat Exchanger Building	
Equipment	$999,000
Labor	$3,646,000
Materials	$809,000
ODCs	$160,000
Subcontract costs (SSE)	$2,605,000
Subtotal	**$8,219,000**
Support and indirect costs (12%)[c]	$986,000
Direct distributables (18.68%)	$1,719,000
G&A (4.98%)	$544,000
Contingency (20%)	$2,294,000
Long-term surveillance and maintenance[b]	$960,000
109-N ISS Total	**$14,722,000**
D&D of the 109-N Steam Generator Cells and Pipe Gallery[c]	
Equipment	$3,077,000
Labor	$9,031,000
Materials	$960,000
ODCs	$3,950,000
Subtotal	**$17,019,000**
Support and indirect costs (12%)[d]	$2,042,000
Direct distributables (18.68%)	$3,561,000
G&A (4.98%)	$1,127,000
Contingency (20%)	$4,750,000
109-N Final D&D Total	**$28,499,000**
Alternative Two Total	**$77,096,000**

[a]Costs are presented in 2004 dollars and rounded to the nearest thousand.
[b]Based on annual maintenance cost for monitoring systems and SSE structure of $15,000 for 64 years.
[c]Cost was estimated by subtracting SSE costs from the 109-N D&D estimate and recalculating the contingency factor.
[d]Includes costs for mobilization, demobilization, and sampling/surveys.
G&A = general and administrative
ODC = other direct costs

Table 4-2. Present-Worth Cost Estimates for Alternative Three (2004 Dollars).

Description of Costs	Estimated Cost ($)[a]
Long-Term S&M of the 105-N and 109-N Facilities	
Long-term S&M of 105-N and 109-N (64 years)[b]	$16,000,000
Roof repair/replacement of 105-N and 109-N (six times)[c]	$16,800,000
Long-Term S&M Total	**$32,800,000**
D&D of the 109-N Heat Exchanger Building	
Equipment	$4,076,000
Labor	$12,677,000
Materials	$1,769,000
ODCs	$4,111,000
Subtotal	**$22,633,000**
Support and indirect costs (12%)[d]	$2,716,000
Direct distributables (18.68%)	$4,735,000
G&A (4.98%)	$1,498,000
Contingency (20%)	$6,316,000
109-N D&D Total	**$37,898,000**
D&D of the 105-N Reactor Building[e]	
Equipment	$2,279,000
Labor	$11,926,000
Materials	$304,000
Allowance for high radiation work	$1,700,000
ODCs	$1,155,000
Subtotal	**$17,435,000**
Support and indirect costs (12%)	$2,092,000
Direct distributables (18.68%)	$3,648,000
G&A (4.98%)	$1,154,000
Contingency (27.7%)	$6,739,000
105-N D&D Total	**$31,068,000**
Alternative Three Total	**$101,766,000**

[a]Costs are presented in 2004 dollars and rounded to the nearest thousand.
[b]$250,000 annual estimated S&M cost for 64 years.
[c]Cost of each roof repair/replacement is $2,800,000. This cost was estimated on 175,264 ft^2 of roof area at $\$15/ft^2$ for repair/replacement. Waste disposal costs estimated on 1,628 m^3 of waste at $\$105/m^3$.
[d]Includes costs for mobilization, demobilization, and sampling/surveys.
[e]Cost was estimated by subtracting SSE costs from the 105-N ISS estimate and recalculating the contingency factor.
G&A = general and administrative
ODC = other direct costs

5.0 ANALYSIS OF ALTERNATIVES

In accordance with CERCLA requirements, removal action alternatives must be evaluated against the following three criteria:

- Effectiveness
- Implementability
- Cost.

Each criterion is briefly summarized in Table 5-1.

A detailed analysis of the no action, ISS, and long-term S&M alternatives being considered in this EE/CA relative to each criterion is provided in the following subsections, followed by a comparison of the alternatives against one another relative to each criterion. Results of the evaluation will be used to identify a preferred removal action alternative. Public acceptance of the preferred alternative will be evaluated after the public is given an opportunity to review and comment on this EE/CA. State acceptance will be evaluated by Ecology. After addressing comments, the Tri-Parties will document the selected removal action in an action memorandum.

5.1 EFFECTIVENESS

As presented in Table 5-1, the effectiveness criterion was subdivided to provide a more comprehensive evaluation in this EE/CA.

5.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is the primary objective of the removal action. This criterion addresses whether the action achieves adequate overall elimination, reduction, or control of risks to human health and the environment posed by the likely exposure pathways. This criterion must be met for a removal action to be eligible for consideration. Evaluation of the alternatives against this criterion is based on qualitative analysis and assumptions regarding the inventory of hazards in the facilities to be addressed by the removal action.

The no action alternative (alternative one) would not eliminate, reduce, or control risks to human health and the environment. Implementation of this alternative would not meet removal action objectives or the threshold criterion for overall protectiveness and, therefore, cannot be considered a viable alternative. Consequently, the no action alternative was not carried forward for further evaluation in this EE/CA.

The ISS alternative (alternative two) would provide overall protection of human health and the environment. Substantial protection would be provided in the near term by conducting an assessment, performing D&D of portions of the N Reactor complex, and constructing the SSE.

A substantial fraction of the contaminated materials from the 105-N and 109-N facilities would be removed and disposed of at the ERDF, thus reducing the potential for a contaminant release. The portions of the 105-N facility outside of the shield walls would be demolished and disposed. Openings in the shield wall containment would be sealed. In the near term, portions of the 109-N facility would also be demolished and disposed. Those portions of the 109-N facility that were to be left in place would be sealed and encased. Sealing and encasing the remaining portions of the 105-N and 109-N facilities would reduce the potential for a release of remaining contaminants. Protection would be continued until the final disposition of the reactor is determined. S&M would be limited to routine inspections of the roof and enclosure. No entries into the facility would be necessary as all openings to the facility would be sealed. There would be minimal potential for worker exposure and the potential for release of contaminants during D&D activities at the 105-N facility and construction of the SSE. There would also be minimal potential for exposure and releases during D&D activities at the 109-N facility. The primary coolant system components (steam generators, surge tank, primary coolant pumps, valves, and piping) that contain high levels of radioactive contamination would remain in place and would be encased within the SSE. Final demolition of the remaining portions of the 109-N facility would occur after the S&M period. By delaying the final D&D of the 109-N facility, there would be additional time for radioactive contaminants to decay, thereby reducing the potential exposure to workers. Strict adherence to radiological, safety, and environmental controls would be needed to minimize these risks.

The long-term S&M alternative (alternative three) would also provide overall protection of human health and the environment. For the duration of the S&M period, continued surveillance and appropriate maintenance would provide minimum protection. At the end of the S&M period, D&D of the 109-N facility and the outer portions of the 105-N facility would be performed. Under this alternative there is a greater potential for worker exposure during periodic S&M activities in the facilities and for a release of contaminants to the environment. This potential increases as the facilities age during the S&M period. Contaminants could be released directly to the environment via a breach in a pipe, containment wall, roof, or other physical control as the facilities age and deteriorate. Contaminants could also be indirectly released to the environment through animal intrusion into the contaminated structures and systems. However, the use of proven control technologies and strict adherence to safety and environmental regulations would reduce these risks. There are uncertainties regarding the ability to maintain the integrity and protectiveness of the 105-N and 109-N facilities during the remaining S&M period. The number and magnitude of repairs would likely increase, and some repairs would be potentially insufficient to maintain facility integrity. All structures and materials from the 109-N facility would be removed and disposed of at the ERDF or another regulator-approved disposal facility at the end of the S&M period. The potential for contaminant exposure to workers during D&D is significant. The primary coolant system components (steam generators, surge tank, primary coolant pumps, valves, and piping) will contain high levels of radioactive materials. Removal and disposal of these materials will potentially expose workers to high levels of radioactivity and potentially release the materials to the environment. By delaying the final D&D of the 109-N facility, there would be additional time for radioactive contaminants to decay, thereby reducing the potential exposure to workers. Strict adherence to radiological, safety, and environmental controls will be needed to minimize these risks. No specific issues have been identified, but there would be risks associated with an unpredictable event.

Alternative two is considered to achieve long-term protection of human health and the environment more effectively than alternative three. Under alternative two, the areas of significant contamination would either be removed and disposed or sealed and protected to prevent release and allow for radioactive decay.

5.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion addresses whether a removal action will, to the extent practicable, meet ARARs and other federal and state environmental statutes. The ARARs must be met for onsite CERCLA actions (CERCLA, Section 121[d][2]). Onsite actions are exempted from obtaining federal, state, and local permits (CERCLA, Section 121[e][1]). Nonpromulgated standards are also to be considered, such as proposed regulations and regulatory guidance, to the extent necessary for the removal action to be adequately protective. The ARARs criterion must be met for an alternative to be eligible for consideration.

Key ARARs associated with the two remaining alternatives include waste management standards, standards controlling releases to the environment, health standards, and standards for protection of cultural and ecological resources. The actions proposed for both alternatives would meet these preliminary ARARs, although the potential for noncompliance with standards for controlling releases to the environment and standards for safety and health could increase as the facilities age under alternative three. A detailed discussion of how the removal action alternatives would comply with ARARs is provided in Appendix A, including other advisories or guidance documents to be considered. Final ARARs to be met during implementation of the selected removal action will be documented in the CERCLA action memorandum associated with this EE/CA.

5.1.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion addresses whether the alternative leaves an unacceptable risk after the removal action has been taken. It also refers to the ability of a removal action to maintain long-term, reliable protection of human health and the environment after removal action objectives have been met.

Alternative two would be protective of human health and the environment for the long term. It would provide a permanent remedy for the portions of the facilities that would undergo D&D because contamination and contaminated structures would be removed and disposed. The SSE structure would be designed to last the entire ISS period of 64 years with proper maintenance and monitoring. This component of the alternative would effectively contain remaining contamination within the facilities until final disposition of 105-N is determined.

Alternative three has been effective in the short term and could be protective for the long term. However, efforts to maintain the necessary level of protection would become increasingly aggressive as the facilities age. Therefore, over the long term, effectiveness of this alternative to remain protective may diminish.

Alternative two is considered to achieve long-term protectiveness more effectively than alternative three. Under alternative two, the SSE structure would provide effective, long-term protection of human health and the environment for contamination associated with the remaining facilities.

5.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment technologies may be employed in a removal action. This criterion assesses whether the alternative permanently and significantly reduces the hazard posed through application of a treatment technology. Destroying the contaminants, reducing the quantity of contaminants, or irreversibly reducing the mobility of contaminants could accomplish this. Reduction of toxicity, mobility, and/or volume through treatment contributes to overall protectiveness.

Alternative two would generate a large volume of contaminated waste, some of which may require treatment to meet waste acceptance criteria at the ERDF (BHI 2002) or other disposal facilities. Wastes generated would include contaminated equipment and structural materials, personal protective equipment, routine maintenance wastes, and expendable materials. Finally, decay of the radioactive materials during the ISS period would reduce the toxicity of the remaining hazardous materials.

Alternative three would generate a relatively small volume of waste in the near term compared to alternative two. Wastes generated would include personal protective equipment, routine maintenance wastes, roofing materials, and expendable materials. The actual quantity of waste generated and potential treatment requirements cannot be estimated at this time, but quantities would be expected to increase over time as the facilities deteriorate and require more extensive maintenance. As with alternative two, there would be a reduction in the toxicity of contaminants due to radioactive decay. In the long term, alternative two and alternative three generate comparable quantities of waste.

Alternative two is considered to reduce toxicity, mobility, and volume of wastes through treatment more effectively than alternative three. Alternative two provides more effective containment of the hazardous materials, which would prevent mobility of wastes and potential spread of contamination. The ISS containment could significantly reduce the total volume of wastes generated during final disposition of the facilities.

5.1.5 Short-Term Effectiveness

The short-term effectiveness criterion refers to an evaluation of the speed with which the remedy achieves protection. The criterion also refers to any potential adverse effects on human health and the environment during the implementation phases of the removal action.

Alternative two would result in a near-term increase in worker exposure and the potential for releases to the environment. Workers would be entering contaminated facilities and handling contaminated materials during D&D. Removal and disposal of contaminated materials would increase the potential for a release to the environment, especially to the air. As demonstrated on previous ISS and D&D projects at the Hanford Site, implementation of mitigation measures such as limiting workers' time in contaminated areas, providing appropriate protective clothing and equipment, stabilizing contaminated surfaces, and dust control would ensure that worker exposure and the potential for release would be minimized. There would be no need for entry into the structure once ISS is completed. The monitoring period following ISS will be performed remotely, and maintenance activities would be performed on the SSE exterior (e.g., roof inspection). In addition, the potential for a release to the environment would decrease substantially as compared to the current potential due to the containment provided by the SSE.

Alternative three would effectively defer intrusive work on the facilities until the final disposition is determined; therefore, there would be no near-term increase in worker exposure or potential for releases. As long as the facilities are controlled and maintained, S&M would be an effective method to prevent releases to the environment in the short term. Surveillance needs, worker entries into the facilities, and associated worker exposure would continue at the current rate. However, it is expected that S&M would become more difficult and less effective at preventing releases as the facilities age and deteriorate. In addition, as the facilities age, facility entries and thus worker exposure would likely increase due to increased maintenance requirements. Although the same D&D activities would be performed under alternative two and alternative three, facility deterioration would result in greater physical hazards to workers if D&D were performed on the 105-N and 109-N facilities following the S&M period.

Both alternatives would be protective immediately. Alternative two could be considered to have "achieved protection" when the D&D activities have been completed and the SSE has been constructed in 2012. Alternative three assumes that S&M would become more difficult and less effective at preventing releases as the facilities age and deteriorate.

5.2 IMPLEMENTABILITY

Implementability refers to the technical and administrative feasibility of a removal action, including the availability of materials and services needed to implement the selected solution.

Alternative two would be implementable. Environmental restoration workers at the Hanford Site are experienced in performing D&D, ISS, and waste disposal operations. The environmental restoration workers have successfully completed ISS for three of the Hanford Site surplus reactors and are in the process of completing ISS for two additional reactors. Techniques and lessons learned from those projects would be applied to ISS of the N Reactor complex. The specialized skills required to design and construct the SSE would be readily available from the current work force at the Hanford Site. Materials needed to complete the SSE would be easily obtained. In terms of waste disposal, the ERDF has been designated via the ERDF ROD (EPA 1995) to receive CERCLA wastes generated on the Hanford Site that meet the ERDF waste acceptance criteria (BHI 2002). If the ERDF were no longer in operation after the S&M period of the ISS, waste would be disposed in another regulator-approved disposal facility. The ERDF has been in operation for several years, and procedures for handling waste are well established. Therefore, the resources and processes for implementing ISS would be in place and available.

Alternative three would also be implementable, assuming the Tri-Parties were amenable to changing the existing Tri-Party Agreement milestone requiring ISS. S&M techniques are widely used throughout the Hanford Site. Environmental restoration workers are currently providing S&M on several retired reactor facilities, including the N Reactor complex. The procedures are in place, and equipment and personnel to perform necessary repairs and maintenance are available. As time passes, the primary difficulties with implementation of S&M would be the increasing deterioration of the facilities due to the natural aging process and obtaining experienced D&D workers to perform the removal action. The potential for releases and increased contamination could be significant as facility roofs deteriorate and underground piping systems corrode and degrade. Deteriorated underground systems would be difficult to detect and repair. This would result in possibly increasing the potential for worker exposure or physical hazards. An obstacle to implementation of alternative three would be the existing Tri-Party Agreement milestone requiring ISS of the N Reactor by 2012, which would require modification. At this time, none of the Tri-Parties has indicated that they would support such a modification.

From a technical standpoint, alternatives two and three are judged comparable in implementability. In the near term, alternative three would be easier to implement than alternative two. This alternative would not require the level of resources and personnel that would be required for alternative two. However, in the long term, implementation of alternative three may become less feasible as the facilities age and deteriorate and experienced D&D workers may not be readily available. In contrast, alternative two becomes more implementable in the long term. S&M for the facilities would be minimal and require significantly less resources and personnel than alternative three. From a regulatory standpoint, implementation of alternative three beyond 2012 will require RL and the regulators to modify Tri-Party Agreement Milestone M-93-20, as the current milestone calls for completion of ISS at N Reactor by September 30, 2012.

Both alternatives two and three would be implementable. However, in the long term, implementation of alternative three may become less feasible as S&M activities would become more frequent and present greater worker protection and engineering challenges. Additionally, it may be more difficult to obtain experienced staff to perform S&M and D&D activities at the facilities. In contrast, experienced D&D workers are available to perform ISS of the facilities by 2012, and staffing for long-term S&M activities required for alternative two would be minimal.

5.3 COST

The cost criterion evaluates the cost of the alternatives and includes capital, operation and maintenance, and monitoring costs. All of the present-worth costs included in this document are estimates. Consistent with guidance established by the EPA and the U.S. Office of Management and Budget, present-worth analysis is used as the basis for comparing costs of cleanup alternatives under the CERCLA program (EPA 1993). Neither cost estimate for alternatives two or three includes costs required for final disposition of the 105-N reactor block.

The total cost of alternative two with ISS of the 105-N and the 109-N facilities and D&D of the remaining portions of 109-N facility is approximately $77 million. Costs include conducting limited S&M activities following ISS until 2068. The cost estimates for alternative two have been based on pre-conceptual detailed estimates. The costs for performing ISS are somewhat higher than the costs for other Hanford Site reactors due to the larger footprint and complexity of N Reactor.

The total cost of alternative three would be approximately $101.8 million. Costs include conducting surveillance operations and routine maintenance on the facilities from 2005 through 2068. The estimate includes roof replacement and repair for the 105-N and 109-N facilities, full D&D of the 109-N facility, and partial D&D of the 105-N facility.

The cost to implement alternative two is about 24% less than the cost for alternative three. The primary difference in the cost of alternatives two and three is the cost for performing S&M of the facilities through 2068.

5.4 OTHER CONSIDERATIONS

Secretarial policy (DOE 1994) and DOE O 451.1B require that CERCLA documents incorporate NEPA values (e.g., analysis of cumulative, offsite, ecological, and socioeconomic impacts) to the extent practicable in lieu of preparing separate NEPA documentation for CERCLA activities. The NEPA regulations (40 CFR 1502.16) specify evaluation of the environmental consequences of proposed alternatives. These include potential effects on the following:

- Transportation resources
- Air quality
- Cultural and historical resources
- Noise, visual, and aesthetic effects
- Environmental justice
- Socioeconomic aspects of implementation.

The NEPA process also involves consideration of several issues such as cumulative impacts (direct and indirect), mitigation of adversely impacted resources, and the irreversible and irretrievable commitment of resources. A NEPA values evaluation of the alternatives is presented in the following subsections. The no action alternative is excluded from the evaluation because it failed to meet the overall protection threshold criterion as documented in Section 5.1.

5.4.1 Transportation Impacts

Neither of the removal alternatives would be expected to create any significant transportation impacts. Alternative two would have short-term impacts on local Hanford Site traffic associated with transportation of waste, equipment, and personnel. Demolition debris and contaminated soil would be transported from the 100-N Area to the ERDF. Alternative two would also require hauling geologic material to the 100-N Area for backfill. All waste transportation would occur on the Hanford Site, primarily on roads where public access is restricted. Minimal offsite impacts would be expected from transportation of waste to offsite sanitary landfills.

Alternative two would also involve transportation impacts from supplying equipment and materials to the 100-N Area and from increases in the work force traffic. This should have minimal impact on the transportation infrastructure.

Alternative three should have minimal transportation impact during implementation of long-term S&M. Use of roadways and the traffic would be minimal. However, the roadways associated with 100-N Area would need to be maintained for at least 64 years. The roads would need to be available for D&D of 109-N, partial D&D of 105-N, and also during final disposition of the 105-N Reactor block. Transportation impacts during D&D of the facilities and final disposition of the 105-N Reactor block would be similar to those described for alternative two. Long-term S&M would delay these impacts and potentially require that roadways be maintained in good condition for a longer period of time.

If adverse impacts to transportation were detected, activities would be modified or halted until the impact is mitigated. Potential mitigation measures for transportation include preparing a transportation safety analysis to identify the need for specific precautions to be taken before any transport activities, closing roads during waste transportation, or use of the existing rail infrastructure.

5.4.2 Air Quality

There are potential air quality impacts associated with each alternative that have not been quantified, but these impacts would be minor based on experience with D&D and ISS activities at other facilities. Alternative two would have potential air quality impacts associated with fugitive emissions of contaminants during facility demolition. There would also be potential dust emissions associated with excavation of backfill at borrow sites and placement of the material in the 100-N Area. Impacts would be the same for the two alternatives, but would occur later for the S&M alternative. Potential emissions would be quantified during design to ensure that emissions are controlled to below allowable limits. No impacts on local or regional air quality would be expected as long as appropriate fugitive emission and dust control measures are implemented. Potential mitigation measures for air resources include the following:

- Removing or stabilizing facility contaminants before demolition
- Using local exhaust and containment systems during demolition

- Packaging and handling wastes to prevent releases
- Implementing dust-suppression measures (both water and water treated with fixatives) to control fugitive dust
- Covering loads when hauling wastes and backfill materials.

An air monitoring plan would be prepared before beginning fieldwork.

5.4.3 Natural, Cultural, and Historical Resources

The potential impacts to natural, cultural, and historic resources are discussed in the following subsections.

5.4.3.1 Natural Resources. Natural resources include biological resources (e.g., wildlife habitat, plants, animals), physical resources (e.g., land, water, air), and human resources (e.g., remediation workers). As documented in Section 2.0, many areas within the 100-N Area have been physically disturbed by construction and operation of the 105-N Reactor, support facilities, and waste sites. Potential impacts to biological resources would be mitigated at borrow sites by obtaining borrow material only from established borrow areas. An excavation period (including cultural and natural resource reviews) is required prior to excavation in borrow areas. Potential adverse impacts at the ERDF, which is located in an area of high-quality shrub-steppe habitat, were addressed in the *Remedial Investigation and Feasibility Study Report for the Environmental Restoration Disposal Facility* (DOE-RL 1994). Alternative two would also have positive impacts on biological resources because the potential for long-term exposure to contaminants would be minimized through removal. Potential impacts to air resources were discussed previously. For alternative two, there would also be a potential for impacts to land and water resources if contaminants were released during the removal action. As the facilities are demolished, there would be a potential for precipitation to contact contaminants and carry them to the soil where they could then migrate to groundwater. Measures that would be implemented to mitigate potential impacts include the following:

- Stockpiling clean topsoil during site preparation and using topsoil for backfill
- Minimizing the size of construction areas
- Performing ecological surveys before remediation
- Avoiding work in the area of a nest during the nesting season
- Locating borrow sites in areas that would only impact low-quality habitat, such as cheatgrass
- Revegetating disturbed areas, as applicable
- Making borrow sites deeper to minimize the lateral extent of disturbance
- Providing engineering/administrative controls and protective equipment for workers.

Impacts would be the same for alternatives two and three, but would occur later for alternative three.

5.4.3.2 Cultural Resources. Because of the extensive ground disturbance resulting from construction of the 105-N Reactor and associated facilities, the likelihood of archaeological remains within the 100-N Area fence line is remote, as discussed in Section 2.0. Cultural resources may be present at borrow sites, which are typically located in otherwise undisturbed areas. Adverse impacts to cultural resources could occur if such resources are encountered and appropriate mitigating actions are not taken. To reduce the potential of a cultural resource disturbance, a cultural resource review will be performed prior to initiating the project. The planned borrow site location would be moved if there was a potential for disturbing cultural resources. However, if cultural resources were encountered, the State Historic Preservation Office and Native American tribes would be consulted to determine appropriate actions for mitigation, resource documentation, or recovery.

5.4.3.3 Historical Resources. As documented in Section 2.0, both of the facilities meet the NHPA criteria for consideration as historically significant properties. A programmatic agreement (DOE-RL 1996) requires that the DOE assess the contents of the historic buildings and structures before any future deactivation, decontamination, or decommissioning activities can be conducted. An associated treatment plan (DOE-RL 1998) identifies those facilities, including facilities in the 100-N Area, recommended for individual documentation. Assessments of the properties have been completed. Physical effects to these eligible properties, up to and including demolition, have been mitigated. Artifacts marked for retention would need to be retrieved and transported to an appropriate curation facility before any demolition activities.

5.4.4 Noise, Visual, and Aesthetic Effects

Alternative two would increase noise levels, but the impacts would be of short-term duration during removal actions and would not affect offsite noise levels. Positive impacts on visual and aesthetic effects would be realized. The existing footprint and skyline of the 105-N and 109-N facilities would be reduced significantly. Noise impacts from alternative three would be comparable to those encountered under alternative two, but would occur much later.

5.4.5 Socioeconomic Impacts

The local economy is closely tied to Hanford Site employment, so changes in the work force associated with this removal action could potentially affect local socioeconomics, although impacts would be relatively small compared to the overall Hanford Site work force of more than 10,000 people. In the near term, the work force required for alternative three would be small. In the long term, alternative three may require support from non-Hanford Site work forces, but the number of resources would not be large and this would not be expected to have a significant cumulative impact on the community. Personnel required to implement alternative two would be selected from existing S&M and remediation work force resources at the Hanford Site, or the opportunity to fill these positions would be made available to subcontractors. The alternatives would meet the principles established by the Hanford Advisory Board Work Group for cultural/socioeconomic impacts and would allow for workforce transition to cleanup activities. Effects on community social services, public services, and recreation are likely to be imperceptible because so few employees would be involved. No mitigation measures have been identified for socioeconomics.

5.4.6 Environmental Justice

Health or socioeconomic impacts to any of the local communities would be minimal for both alternatives, so environmental justice issues (e.g., high and disproportionate adverse health and socioeconomic impacts on minority or low-income populations) would not be a concern.

5.4.7 Irreversible and Irretrievable Commitment of Resources

Removal actions at the facilities included in the scope of this EE/CA could require an irreversible or irretrievable commitment of resources, particularly land use and geologic materials. Both alternatives would result in land use loss to some extent. The facilities would eventually be removed, allowing for other uses in accordance with current land-use planning. Contamination above cleanup standards might remain at depth even after soil contamination is addressed in accordance with the 100-NR-1/100-NR-2 ROD (EPA 2000b), and this would require restrictions on deep excavations and well drilling. The S&M alternative would require additional restrictions during the interim phase, until the final disposition is performed. Both alternatives would also result in land-use loss for ERDF disposal because the ERDF would need to be expanded to accommodate D&D waste.

Irretrievable and irreversible commitment of resources would occur with both alternatives in the form of petroleum products (e.g., diesel fuel, gasoline) and geologic materials required to backfill and recontour the sites following D&D. Geologic material would be obtained from onsite borrow pits. Although alternative two would use more of these resources in the near term, the quantities of required petroleum and geologic resources would be the same for both alternatives. In addition, there would be a small increase in the amount of material required for the closure barrier at the ERDF.

5.4.8 Cumulative Impacts

Removal actions at the facilities included in the scope of this EE/CA could have impacts when considered together with impacts from past and foreseeable future actions at and near the Hanford Site. Authorized current and future activities in the 100-N Area that may be ongoing during removal actions include soil and groundwater remediation and S&M of facilities. Other Hanford Site activities include D&D of a variety of facilities, soil and groundwater remediation, operation and closure of underground waste tanks, construction and operation of tank waste vitrification facilities, removal and storage of spent nuclear fuel from the K Basins, and operation of the Energy Northwest commercial reactor. Activities near the Hanford Site include a privately owned radioactive and mixed waste treatment facility, a commercial fuel manufacturer, and a titanium reprocessing plant.

Both removal action alternatives would have minimal impacts on transportation; air quality; natural, cultural, and historical resources; noise, visual, and aesthetic effects; public health; and socioeconomics. Impacts would be the same for both alternatives, but would occur later for alternative three. Therefore, cumulative impacts (with respect to these values) are expected to be insignificant. Cumulative impacts could occur with respect to the irretrievable and irreversible commitment of resources and funding priority.

Both alternatives would require excavation of geologic material from borrow sites for backfill and cover, resulting in an irretrievable and irreversible commitment of geologic materials. The proposed 100-N Area actions constitute only one of numerous actions requiring material for barriers and backfill at the Hanford Site. The total quantity of geologic materials required for Hanford Site actions was evaluated in a separate NEPA evaluation.

Both alternatives could also require long-term land-use restrictions in the 100-N Area. As documented in Section 2.0, the future land use in the 100 Area is anticipated to be conservation/preservation. Consequently, the land-use restrictions that would be imposed by either alternative would be compatible with other decisions and would not result in a cumulative impact for land use.

Table 5-1. Summary of Evaluation Criteria.

Effectiveness[a]	**Overall Protection of Human Health and the Environment.** The primary objective and a "threshold" criterion that must be met for a removal action to be eligible for consideration. This criterion addresses whether the alternative achieves adequate overall elimination, reduction, or control of risks to human health and the environment posed by the likely exposure pathways. Assessments of the other evaluation criteria are also drawn upon. Evaluation of the alternatives against this criterion was based on qualitative analysis and assumptions regarding the inventory of hazards in the 105-N and 109-N facilities.
	Compliance with Applicable or Relevant and Appropriate Requirements. Like overall protection of human health and the environment, compliance with ARARs is a threshold criterion that must be met for an alternative to be eligible for consideration. This criterion addresses whether a removal action will, to the extent practicable, meet ARARs and other federal and state environmental statutes. The ARARs must be met for onsite CERCLA actions (CERCLA, Section 121[d][2]). Onsite actions are exempted from obtaining federal, state, and local permits (CERCLA, Section 121[e][1]). Nonpromulgated standards (e.g., proposed regulations, regulatory guidance) are also to be considered to the extent necessary for the removal action to be adequately protective.
	Long-Term Effectiveness and Permanence. The long-term effectiveness and permanence criterion addresses whether the alternative leaves an unacceptable risk after the removal action has been completed. It also refers to the reliability of a removal action to maintain long-term protection of human health and the environment after implementation.
	Reduction of Toxicity, Mobility, or Volume Through Treatment. The reduction of toxicity, mobility, or volume through treatment criterion refers to an evaluation of the anticipated performance for treatment technologies that may be employed in a removal action. It assesses whether the alternative permanently and significantly reduces the hazard posed through application of a treatment technology. This could be accomplished by destroying the contaminants, reducing the quantity of contaminants, or irreversibly reducing the mobility of contaminants. Reduction of toxicity, mobility, and/or volume contributes to overall protectiveness.
	Short-Term Effectiveness. The short-term effectiveness criterion refers to an evaluation of the speed with which the remedy achieves protection. This criterion also refers to any potential adverse effects on human health and the environment during the implementation phases of the removal action.
Implementability	Implementability refers to the technical and administrative feasibility of a removal action, including the availability of materials and services needed to implement the selected solution.
Cost	The cost criterion evaluates the cost of the alternatives and includes capital, operation and maintenance, and monitoring costs.

[a]To provide a more comprehensive evaluation, the effectiveness criterion has been divided into several subcategories.

6.0 RECOMMENDED ALTERNATIVE

The recommended alternative to conduct a removal action at the 105-N facility is alternative two, ISS of the 105-N and 109-N Buildings. This alternative is recommended based on its overall ability to provide protection of human health and the environment and its effectiveness in maintaining protection for both the short term and long term. The alternative would reduce the potential long-term threat to workers who could be exposed to facility contaminants during extended periods of S&M and would reduce the potential for a release by reducing the inventory of contaminants and containing remaining contaminants.

Alternative two would provide the best balance of protecting human health and the environment, protecting workers, meeting the removal action objectives, achieving cost effectiveness, and providing an end state that is consistent with future cleanup actions and commitments to the Tri-Party Agreement (Ecology et al. 1998). Implementation of alternative two facilitates a final disposition decision on the N Reactor by removing much of the potentially contaminated materials, protecting the remaining contaminated structures, and allowing decay of remaining radioactive contamination until final disposition is accomplished.

Alternative two would involve assessment, partial D&D of the 105-N and 109-N facilities, ISS of the remaining facilities, construction of SSE structures over 105-N and 109-N, waste disposal, and long-term S&M of the SSE structure, followed by D&D of the remaining portions of 109-N. The ERDF would primarily be used for waste disposal, which provides an engineered disposal facility that is protective of the environment. Liquids containing levels of hazardous substances, subsequent to meeting waste acceptance criteria, would be sent to the Effluent Treatment Facility. Any offsite waste disposal would require a determination by the EPA, with Ecology notification. Contaminants remaining in the 105-N Reactor block and in the 109-N steam generator cells and pipe gallery enclosed in the SSE, would be substantially isolated and would allow for a significantly reduced S&M program until final disposition of these buildings can be achieved. If final disposition occurs as late as 2068, the ERDF will most likely be closed, and waste generated from final disposition of 109-N would be disposed at another regulator-approved disposal facility.

7.0 SCHEDULE

For information purposes only, Figure 7-1 provides a schedule of the proposed removal action alternative. Sampling and analysis plans (for waste designation and final verification) and the identified removal action work plan will be submitted to the regulators for concurrence.

Table 7-1 identifies the Tri-Party Agreement milestones associated with disposition of the 105-N and 109-N facilities.

Figure 7-1. N Reactor Complex Interim Safe Storage Project Schedule.

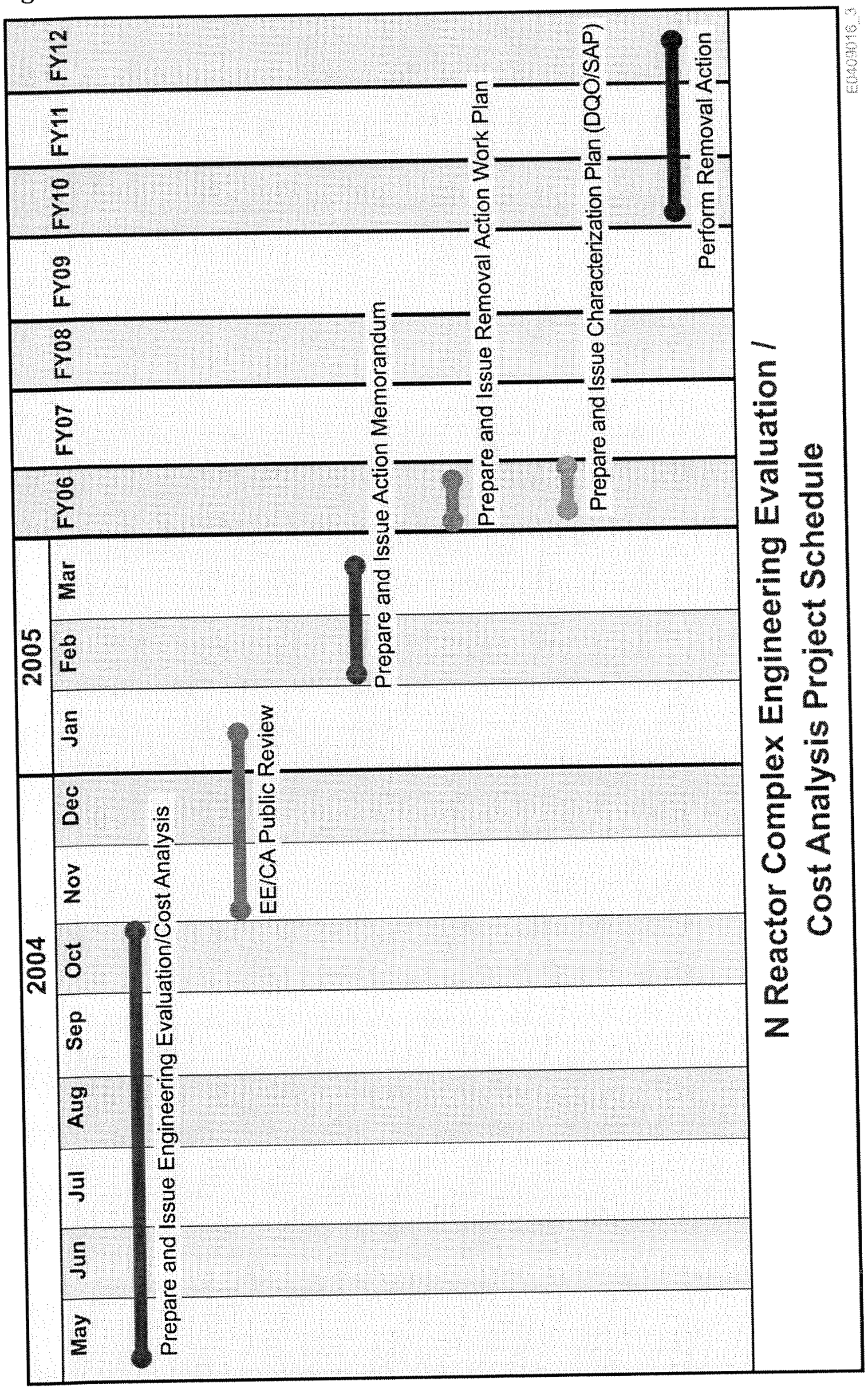


Table 7-1. Tri-Party Agreement Milestones for the 105-N and 109-N Facilities.

Milestone	Description	Due Date
M-93-00	Complete final disposition of all 100 Area surplus production reactor buildings. 100 Area surplus production reactor buildings consist of the following: 105-D, 105-DR, 105-H, and 105/109-N (Ecology lead), and 105-B, 105-C, 105-F, 105-KE, and 105-KW (EPA lead).	TBD
M-93-19	Submit to EPA and Ecology the 105/109-N Reactor interim safe storage design.	September 30, 2009
M-93-20	Complete 105-N Reactor interim safe storage.	September 30, 2012
M-93-24	Submit engineering evaluation/cost analysis for 105-N Reactor interim safe storage.	July 30, 2006

TBD = to be determined

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APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A.1 INTRODUCTION

40 *Code of Federal Regulations* (CFR) 300.415(j) requires that applicable or relevant and appropriate requirements (ARARs) be met (or waived) to the extent practicable during the course of removal actions. When requirements are identified, a determination must be made as to whether those requirements are applicable or relevant and appropriate. A requirement is applicable if the specific terms (or jurisdictional prerequisites) of the law or regulations directly address the circumstances at a site. If not applicable, a requirement may nevertheless be relevant and appropriate if (1) circumstances at the site are, based on best professional judgment, sufficiently similar to the problems or situations regulated by the requirement; and (2) the use of the requirement is well suited to the site.

To-be-considered (TBC) information is nonpromulgated advisories or guidance issued by federal or state governments that is not legally binding and does not have the status of potential ARARs. The TBCs complement ARARs in determining what is protective at a site or how certain actions should be implemented.

A preliminary assessment has identified the following key ARARs for the alternatives being considered in this document:

- Waste management standards
- Standards controlling releases to the environment
- Environment and health radiological standards
- Cultural, historical, and ecological protection standards.

Other standards that are not environmental standards (and thus not ARARs) but which must be met during implementation of the removal action or that should be considered include various U.S. Department of Energy (DOE), federal, and state worker safety standards. Final ARARs, which must be complied with during implementation of the selected removal action, will be documented in the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) action memorandum.

A.2 COMPLIANCE WITH ARARS

A discussion of how the interim safe storage (ISS) and surveillance and maintenance (S&M) removal action alternatives would comply with the listed preliminary ARARs is provided in the following sections. Where pertinent to the discussion of compliance, TBC items have also been included. The no action alternative is excluded from the discussion because it fails to meet the threshold criterion for overall protection of human health and the environment as previously documented in Section 4.0 of this engineering evaluation/cost analysis (EE/CA).

A.2.1 Waste Management Standards

Applicable waste management standards are identified for hazardous/dangerous waste, polychlorinated biphenyl (PCB) waste, radioactive waste, and asbestos in the following subsections.

A.2.1.1 Hazardous/Dangerous Waste. Subtitle C of the *Resource Conservation and Recovery Act of 1976* (RCRA) governs the identification, treatment, storage, transportation, and disposal of hazardous waste. Authority for most of the Subtitle C provisions has been delegated to the state of Washington. State dangerous waste management regulations promulgated pursuant to this delegated authority and the *Washington Hazardous Waste Management Act of 1976* are codified in accordance with *Washington Administrative Code* (WAC) 173-303 and would be applicable to any dangerous wastes (under the state authority, the term "dangerous waste" is used instead of the term "hazardous waste") that may be generated under this removal action. The regulations require identifying and appropriately managing dangerous wastes and dangerous waste components of mixed wastes, as well as identifying associated treatment and disposal standards. Land disposal restrictions (LDRs) established under RCRA (40 CFR 268) prohibit disposal of restricted wastes unless specific concentration- or technology-based treatment standards have been met. Washington State LDRs are established under WAC 173-303-140. The LDRs would be applicable to the treatment and disposal of dangerous or mixed wastes that may be generated during the removal action.

Dangerous and mixed wastes would likely be generated under both alternatives. At this time, it is expected that these wastes would be primarily characteristic dangerous wastes (e.g., lead-contaminated materials). Some listed dangerous wastes (e.g., organic solvents) may also be generated. Both characteristic and listed dangerous or mixed wastes would be designated and managed in accordance with WAC 173-303. The LDRs would be applicable to the treatment and disposal of dangerous or mixed wastes that may be generated during the removal action. Any wastes determined to be dangerous or mixed waste would be treated, as appropriate, to meet the standards of 40 CFR 268 and WAC 173-303-140 before disposal. For example, lead-contaminated waste could be encapsulated.

After treatment, as appropriate, dangerous and mixed waste that meets the requirements of the *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (BHI 2002) would be disposed of at the Environmental Restoration Disposal Facility (ERDF), which is authorized to receive such waste. Any waste that does not meet ERDF waste acceptance criteria would be staged within the area of contamination or sent to an onsite dangerous waste storage area that meets the substantive requirements of WAC 173-303 and subsequently disposed of at an approved dangerous waste disposal facility. Offsite disposal would require an offsite acceptability determination in accordance with 40 CFR 300.440 from the U.S. Environmental Protection Agency (EPA), with notification to the Washington State Department of Ecology (Ecology).

A.2.1.2 Polychlorinated Biphenyl Waste. The *Toxic Substances Control Act of 1976* (TSCA), as implemented by "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions" (40 CFR 761), regulates the management and disposal of PCBs and PCB waste. PCB-contaminated waste would likely be generated under both alternatives and would be managed in accordance with 40 CFR 761 requirements for PCB remediation waste. The ERDF is authorized to accept nonliquid PCB wastes for disposal. All PCB waste that meets the waste acceptance criteria (BHI 2002) would be disposed of at the ERDF. Any PCB waste that does not meet ERDF waste acceptance criteria would be staged within the area of contamination or sent to an onsite PCB storage area that meets the substantive requirements of 40 CFR 761.65 and subsequently transported offsite to a TSCA-approved waste disposal facility. Offsite disposal would require an offsite acceptability determination in accordance with 40 CFR 300.440 from EPA, with notification to Ecology.

A.2.1.3 Radioactive Waste. Radioactive wastes are governed under the authority of the *Atomic Energy Act of 1954*. The U.S. Nuclear Regulatory Commission performance objectives for land disposal of low-level radioactive waste are provided in "Licensing Requirements for Land Disposal of Radioactive Waste" (10 CFR 61, Subpart C). Although not applicable to DOE facilities, these standards are relevant and appropriate to any disposal facility that would accept radioactive or mixed waste generated under this removal action. Low-level radioactive waste would be generated under both alternatives being considered for this removal action. Provided that this waste meets the waste acceptance criteria, it would be disposed of at the ERDF, which is authorized to receive low-level waste resulting from CERCLA activities.

A.2.1.4 Asbestos. The removal of asbestos and asbestos-containing material (ACM) is regulated under the *Clean Air Act of 1955* as implemented by "National Emissions Standards for Hazardous Air Pollutants" (40 CFR 61, Subpart M). These regulations provide standards to ensure that emissions from asbestos are minimized during collection, processing, packaging, and transportation. Handling of asbestos and/or ACM would be required for either of the removal action alternatives. Asbestos and/or ACM would be removed and disposed of at the ERDF in accordance with the cited regulations, including appropriate packaging.

A.2.2 Transportation

The *Hazardous Materials Transportation Act of 1974*, as implemented by "Requirements for the Transportation of Hazardous Materials" (49 CFR 100 through 49 CRF 179), governs the transportation of potentially hazardous materials (including samples and waste) on public roads. This regulation is applicable to any wastes or contaminated samples that would be shipped off the Hanford Site. Either alternative could require offsite transportation of contaminated waste and potentially contaminated samples. Compliance with this ARAR would be met through implementation of DOE orders and federal procedures (e.g., DOE O 460.1A, *Packaging and Transportation Safety,* and *Revised Procedures for Planning and Implementing Off-Site Response Actions* [EPA 1987]).

A.2.3 Disposal

The disposal requirements for ERDF and other disposal facilities are presented in the following subsections.

A.2.3.1 ERDF. Because both alternatives would include disposal of waste at the ERDF, the ERDF waste acceptance criteria (BHI 2002) must be met. The ERDF waste acceptance criteria (which are a TBC item) define radiological, chemical, and physical characteristic criteria for disposal of waste at the facility.

A.2.3.2 Other Disposal Facilities. Waste generated during the implementation of either alternative that could not meet or be treated to meet the ERDF waste acceptance criteria would be stored or disposed at an alternate Ecology- and EPA-approved facility. Any waste disposal occurring off the Hanford Site would require an offsite acceptability determination in accordance with 40 CFR 300.440 by the EPA, with notification to Ecology.

A.2.4 Standards Controlling Releases to the Environment

The proposed removal action alternatives have the potential to generate airborne emissions of pollutants.

The federal *Clean Air Act* and the "Washington Clean Air Act" (*Revised Code of Washington* [RCW] Chapter 70.94) regulate both criteria/toxic and radioactive airborne emissions. Under implementing regulations found in 40 CFR 61, Subpart H, and WAC 246-247, radionuclide airborne emissions from all combined operations on the Hanford Site may not exceed 10 mrem/yr effective dose equivalent to the hypothetical maximally exposed individual at the nearest unrestricted area where any member of the public may be. WAC 246-247 also requires verification of compliance and the use of best available radionuclide control technology or as low as reasonably achievable control technology. Radionuclide emissions from point sources, nonpoint sources, and fugitive sources are to be measured. Measurement techniques may include, but are not limited to, sampling, calculation, smears, or other reasonable methods for identifying emissions as determined by the lead regulatory agency.

WAC 173-400 and 173-460 establish requirements for emissions of criteria/toxic air pollutants. The primary source of emissions would be fugitive particulate matter. WAC 173-400-040 identifies general standards for control of fugitive emissions resulting from materials handling, construction, demolition, or other operations. WAC 173-460 would be relevant and appropriate to removal actions that require the use of a treatment technology that emits toxic air pollutants. Treatment of some waste may be required to meet the ERDF waste acceptance criteria prior to disposal for two of the alternatives. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques such as macroencapsulation or grouting, and would not be subject the WAC 173-460 requirements. If more aggressive treatment is required, the requirements of the standard would be meet.

Particulate emissions would be controlled through standard industrial practices including, but not limited to, application of water spray, fixatives, and/or temporary confinement enclosures/glovebag containments. Both alternatives are expected to comply with these standards.

A.2.5 Safety and Health Requirements

Safety and health requirements are not potential ARARs under CERCLA but are included in the discussion for the sake of completeness. The DOE radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation are specified in "Occupational Radiation Protection" (10 CFR 835). The rule also requires that measures be taken to maintain radiation exposures as low as reasonably achievable. In addition, DOE must meet Occupational Safety and Health Administration requirements for worker protection (e.g., 29 CFR 1910, "Occupational Safety and Health Standards," and 29 CFR 1926, "Safety and Health Regulations for Construction"), national consensus standards, and DOE orders. Exposure limits, personnel protection requirements, and decontamination methods for hazardous chemicals are established by 29 CFR 1910. Identification and mitigation of physical hazards posed by a facility including (but not limited to) confined spaces, falling hazards, fire, and electrical shock are also required. 29 CFR 1926 provides requirements for worker safety during construction activities. The applicable DOE orders require analysis of hazards posed by work activities and identification of controls necessary to work safely.

Under either alternative, radiological and physical hazards would be identified and analyzed prior to the start of field activities, and appropriate measures for mitigation would be addressed in a task-specific health and safety plan. A combination of personal protective equipment, personnel training, and administrative controls (e.g., limiting time in and distance from radiation zones) would be used to ensure that the requirements for worker protection are met. Individual monitoring would be performed, as necessary, to verify compliance with the requirements.

A.2.6 Cultural, Historical, and Ecological Resource Protection Requirements

Requirements associated with archeological remains, human remains, historical artifacts, endangered species, and migratory birds are presented in the following subsections.

A.2.6.1 Archeological Materials. The *Archeological and Historic Preservation Act of 1974* provides for the preservation of historical and archeological data (including artifacts) that might be irreparably lost or destroyed as the result of a proposed action. The facilities included in the scope of this EE/CA are located in an area that is highly disturbed from past operations. The likelihood of encountering archaeological materials within the footprint of these facilities would be low for either alternative. The likelihood would be greater at borrow sites from which backfill material might be obtained under the ISS alternative. Awareness training would be provided to site workers to address this possibility. If archeological materials were discovered, a mitigation plan would be developed in consultation with the appropriate authorities.

A.2.6.2 Human Remains. The *Native American Graves Protection and Repatriation Act of 1990* (as regulated by 43 CFR 10) requires agencies to consult and notify culturally affiliated tribes when Native American human remains are inadvertently discovered during project activities. It is unlikely that work proposed in this EE/CA would inadvertently uncover human remains. If human remains were encountered, the procedures documented in the *Hanford Cultural Resources Management Plan* (DOE-RL 2003) would be followed.

A.2.6.3 Historical Artifacts. The *National Historic Preservation Act of 1966* (as regulated by 36 CFR 800) requires federal agencies to evaluate historic properties for eligibility in the National Register of Historic Places (NPS 1988) and to mitigate adverse effects of federal activities on any site eligible for listing in the National Register. A programmatic agreement that was prepared by DOE specifies how activities at the Hanford Site will comply with the requirements to identify, evaluate, and treat buildings and historic archaeological remains from the Hanford era (DOE-RL 1996). The accompanying treatment plan directs the process for evaluating properties on the Hanford Site and identifies those facilities (including facilities in the 100-N Area) that are contributing facilities recommended for individual documentation (DOE-RL 1998). Appropriate documentation has been completed for the contributing facilities in the 100-N Area. Interior assessments of the 100-N facilities have been conducted to identify and tag artifacts that may have interpretive or educational value. Tagged items would be removed from facilities and transferred to safe storage before any activity that would disrupt such items.

A.2.6.4 Endangered Species and Migratory Birds. The *Endangered Species Act of 1973*, which is implemented by 50 CFR 402, requires the conservation of critical habitat on which endangered or threatened species depend, and prohibits activities that threaten the continued existence of listed species or destruction of critical habitat. The *Historic Migratory Bird Treaty Act of 1918* makes it illegal to remove, capture, or kill any migratory bird or any part of nests or the eggs of any such birds. Although threatened and endangered species of migratory birds are known to be present in the 100 Area, no adverse impacts on protected species or critical habitat resulting from implementation of either alternative would be anticipated because the removal action would be limited to areas highly disturbed from past operations. Potential impacts to biological resources would be of greater concern at borrow sites because they are located in otherwise undisturbed areas. Activity-specific ecological reviews would be conducted to identify potentially adverse impacts before beginning fieldwork.

A.3 REFERENCES

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10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

29 CFR 1926, "Safety and Health Regulations for Construction," *Code of Federal Regulations*, as amended.

36 CFR 800, "Protection of Historic and Cultural Properties," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations,* as amended.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations,* as amended.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

43 CFR 10, "Native American Graves Protection and Repatriation Regulations," *Code of Federal Regulations*, as amended.

49 CFR 100-179, "Requirements for the Transportation of Hazardous Materials," *Code of Federal Regulations,* as amended.

50 CFR 402, "Interagency Cooperation – Endangered Species Act of 1973," *Code of Federal Regulations*, as amended.

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Hazardous Materials Transportation Act of 1974, 49 U.S.C. 1801-1813, et seq.

Historic Migratory Bird Treaty Act of 1918, 16 U.S.C. 703, et seq.

National Historic Preservation Act of 1966, 16 U.S.C. 470, et seq.

Native American Graves Protection and Repatriation Act of 1990, 25 U.S.C. 3001, et seq.

NPS, 1988, *The National Register of Historic Places*, National Park Service, U.S. Department of the Interior, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Toxic Substances Control Act of 1976, 15 U.S.C. 2601, et seq.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Protection -- Air Emissions," *Washington Administrative Code*, as amended.

Washington Clean Air Act of 1967, Revised Code of Washington 70.94, as amended.

Washington Hazardous Waste Management Act of 1976, as amended.

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40 CFR 260, "Hazardous Waste Management System: General," *Code of Federal Regulations*, as amended.

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations,* as amended.

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations,* as amended.

40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste," *Code of Federal Regulations,* as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations,* as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," *Code of Federal Regulations,* as amended.

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